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Engineering News-Record

A Turbine Hall Made Attractive
—Philadelphia's Latest Power Station

Exceptional Steelwork in Power Station
By Frank N. Kneas

The Pacific Coast Revisited
By Frank C. Wight

A Nineteen-Story Concrete Building
By William F. Zabriskie and W. S. Wolfe

San Francisco Fills Shore Low Lands with Destructor Refuse

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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FRANK C. WIGHT
Editor

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Street Benefit Assessments

AMONG other things that the automobile has brought is a changing attitude toward street paving benefit assessments. Time was when it was highly desirable to have a well paved street in front of one's residence and when this desirability brought with it added value to the property. Then it was fair to charge the abutting owner with a part of the cost of street improvement, not only because his property value actually increased but because it brought to him individual benefit. But the omnipresent automobile has changed all that. Residence on a well paved thoroughfare no longer means merely easy access to one's home. It means a constant procession of cars passing the house with the consequent added danger to life and limb, especially of children, and the manifold minor annoyances of sound, sight and smell. It is a fact that residence property off the main traveled way is becoming more valuable than on the boulevard—and this tendency extends beyond the city into the country, provided in both cases the way to the main highway is at least passable. To charge a man for the rebuilding of a usable street pavement in front of his home and then to increase his taxes by raising his assessed valuation, just to provide easier riding for the through traveler who is a nuisance to the home owner, is rubbing it in. Roads and streets are public utilities and the public ought to pay for them en masse—at least until some more workable scheme can be developed than by charging in proportion to frontage on the highway.

To Improve Concrete

SOME years ago the Bureau of Standards reported that it had under study over one hundred different kinds of "dopes" for concrete, materials of one kind or another which were designed to make concrete more dense, or harder, or more watertight. These were all divisible into a few basic types; some had a bituminous base, some were calcium chloride of varying degrees of purity, some were soaps, some were fluosilicates—but each had a dignified name, and for each special claims of superiority were made. Proof as to the value of these compounds still remains largely a matter of individual interpretation, for while the rigid laboratory tests rarely indicated either relative or actual superiority of the different materials, there still are a great many practical concrete men who believe that in service they have found the concrete treated by a favored material to be superior to the concrete plain and unadorned. However that may be, the chances are that such virtues as any one possesses are shared by many others, for there are only a few variations in real composition. The situation now has become more complicated because post-war necessity has flooded this country with a number of German compounds designed to improve concrete. American users may consider the use of these without prejudice, of course, but they should keep in mind that they are not anything new and that there are dozens of American products strictly comparable to every German one here offered. There has been no magic discovery in Germany, or anywhere else, of a mysterious something that solidifies concrete. If you think you can make better concrete by putting something in it or on it, you are entitled to your own opinion but don't take for granted all the claims for sole possession of superior qualities that are made by those who are promoting these vivifying commodities.

Lightning Strikes Road

LIGHTNING is coming into notice as a hazard to concrete roads. Twice within the last six years we have reported the destruction, once of a bridge pavement and railing and once of a road slab, by the caperings of the Jovian bolt. Another road has been struck and the record is sufficient to arouse astonishment and engender respect. The road is in Escambia County, Florida, whose engineer W. E. Wheat, confirmed by B. O. Howe, assistant engineer on the Louisville & Nashville R.R., describes what happened in a short paper contributed to the American Society of Civil Engineers. The bolt struck the pavement and split, part going one way and part the opposite way following the reinforcement about 720 ft. in each direction before plunging into the ground. In searching out the path of least resistance along the reinforcing mesh the current jumped across the pavement often, generally at joints, where, in arcing across the interrupted mesh, it caused enough heat to burst out concrete spalls about a foot in area and coning down to the steel some two inches below the slab top. Deductions from his studies are not attempted by Mr. Wheat and the editor feels it best to use similar discretion. One might inquire, however, whether, besides reinforcing against cracking and load, he should reinforce against lightning. We don't know. Pavements are disclosing such sensitive souls as research and crack-surveys delve increasingly deeper that we are all the time growing less confident in speaking about them.

Esthetics in Industry

CONSCIOUS seeking after grace and beauty of form in utilitarian construction is a rare thing. Not wholly new, it is still so unusual that every new instance is of sensational importance. And especially where esthetic design is of such a high type as in the Richmond power station, a stimulative model presents itself. The Philadelphia structure shows what can be accomplished in the direction of making a great electric station monumental rather than barely tolerable. At the same time, it exemplifies some highly interesting means

to this end. Skillful application of architectural principle and craft resulted in an exterior that makes the huge structure impressive and appealing in its general aspect. Individual elements of the picture are quite as effective, prominent among them the almost ornate coaling tower and the boldly arcaded conveyor bridge. Among the interior elements, the turbine hall stands out pre-eminently. Its vaulted roof, surpassing the much discussed roof structure of the Pennsylvania Terminal concourse in New York, gives an admirable setting to the four giant turbine sets. At the same time—and this expresses itself clearly in the exterior view—the roof makes available light and air in a degree difficult to realize with more conventional powerhouse roof types. In short, architect and engineer have achieved something notable in the Richmond station, something that will inspire others to follow along the same path of endeavor. The industrial structure has a distinct opportunity to contribute toward making the world as attractive and pleasing as it might be, but unfortunately it is very far from grasping this opportunity. The greater value, therefore, in a shining example. In this connection it may also be a justifiable reflection that the prudent Quakers who held the purse strings in the building of the Richmond station were probably not moved wholly by philanthropic stirrings when they consented to an ambitious architectural development. It must have occurred to them that their partnership with the public is made smoother and better by any uplifting esthetic impression which their structure may carry, and that in this way the emotional background of their business is improved. In short, they probably perceived that good architecture is good business, even in the prosaic activity of collecting dollars in exchange for kilowatt hours.

Group Safety Engineering Grows

FOR eight years a little group of constructors have gathered at the yearly safety congress of the National Safety Council and kept going the construction section of that organization. The section has grown gradually in membership and activity. Still, in view of the urgency and importance of accident prevention in construction, the membership is pitiably small. It contains only a handful of real workers for the section and the council. Indeed it would be discouraging if we were compelled to believe that their meager representation in the construction section of the National Safety Council was truly indicative of the progress of safety thinking and accident prevention practices among constructors. We need not believe this. There has been in these eight years since 1918 a revolution in the attitude of the construction business toward accidents.

The increased consciousness of safety as a factor in construction is attributable to several influences. Increasingly drastic employers liability legislation is one. Humanitarianism is naturally one. The lesson that accident prevention is practicable and not too costly for small operators or small operations is one. And finally the most important one is the growing conviction that increasing the safety of construction is profitable. One shirks the thought that other influences than man's love for man appear to predominate but the conclusion may not be escaped. It has been the money advantage of being safe which has most advanced construction safety. Until constructors began to be appealed to by pocket-book argument their violent interest in preventing accidents was not particularly obvious. "A man a floor" was the flippant saying and, very nearly, the serious truth. Truly the constructor did not understand what else could be expected. He was not callous. He thought of death and injury as factors of his vocation.

General conviction that construction safety is financially practicable in a general way has come in the last half-dozen years. It took constructors in Detroit and then in Milwaukee and then in one or two other localities to show that group safety engineering was the way of bringing costs to the individual so low that accident prevention measures were feasible on the smallest operation by the smallest constructor. The account of the work of these pioneer mutual organizations for accident prevention has been given too often and too recently to justify repetition but every contractor who has not heard it should make it part of his familiar knowledge.

Construction safety is obtainable by group action and it is profitable to the group and the individual. Even though his accidents have been and will be no great expense to him, the individual participates in the lowering of liability insurance rates which invariably follows group or individual safety engineering work. This month at Detroit the program of the construction section at the National Safety Congress will explain in two papers group safety engineering practice. Contractors should obtain these papers or better join the section, sit in at the meetings and listen to papers and discussions. In no very great time the constructor who has no agency for systematic accident prevention work is going to be handicapped in his competitive race with constructors who have.

A Popular Revolt

TRIVIAL matters sometimes have unexpected results, as was exemplified in a new way within the last month. On the occasion of a test of an electrically welded plate girder at the federal Bureau of Standards, a colorful little press release was sent out, proclaiming the advent of silent, rivetless building through the aid of the Bureau's work. The paragraph was an ingenious flight of fancy, but had little ballast of fact, and it seemed certain that newspaper editors, recognizing its emptiness, would promptly consign it to the waste basket. But strangely enough the flight of fancy turned out to have an unexpected and amazingly strong popular appeal which saved it from the burning. Scores of newspapers all over the country reprinted it, and told their readers that noisy riveting has at last been abolished and that silent building has come.

What particular idea or purpose led the newspapers to print the item is perhaps arguable. But newspapermen have a keen understanding of what the majority needs or wants, and their instant response in the Bureau of Standards case has all the earmarks of a popular movement in the bud. It seems to foreshadow a general revolt against the rivet and its inevitable companion, the "gun"—the compressed-air riveting hammer. And obviously such a revolt would be a significant development.

Some words of a distinguished scientist strongly reinforce the newspaper evidence. Dr. Irving Langmuir last week delivered a fascinating address to the American Chemical Society, in which he retold the story of his discovery of "flames of atomic hydrogen," to use

the striking title under which he published the account a few months ago. Hydrogen dissociated in his electric arc and recombining to molecular form a short distance away produces an intensely hot blast and thus furnishes a welding heat far superior to that of the arc, especially because the hydrogen stream protects the fused metal from oxidation and other harmful contaminations.

Doctor Langmuir said that better welding than hitherto possible can be done with this "flame." He might well have rested the argument on specific mention of what materials can be welded and what qualities of weld can be obtained with the atomic hydrogen arc; but to make the point most graphic, to make the strongest possible appeal, he sought out the vulnerable side of his hearers' interest: he promised them the coming of the rivetless building and the resultant abolition of noise. It was the same bit of psychology that the Bureau of Standards press item had exploited. The scientist, precisely like the press agent, had the instinctive certainty that one of the public's great vital interests lies in the abolition of the rivet; and doubtless he felt that if his remarkable scientific discovery should bring about this result, it would have demonstrated its practical value most brilliantly.

Of course, people at large have no sentiment against rivets, or for welds. But on the subject of the gun many people have strong feelings indeed. Whoever has had his ears insulted and tortured in and out of season by the insistent obtrusiveness of the modern mechanical woodpecker is likely to respond with pleasurable interest when the news is printed that the rivet is to go, for to him the rivet is only a symbol for the gun. He remembers how often he has bottled up choice imprecations when the drumming of the riveting hammer bored into his brain and drove thought away from useful purpose. His mind is fertile ground for any suggestion of a means for abolishing the rivet, and if welding will do away with the rivet he is ready to root for welding, regardless of its technical feasibility.

Structural engineers heretofore appear to have cherished the gun as they do the rivet—faithful servants both. They have obtruded their drumming hammers upon the world anywhere and everywhere with no thought of their audience. Perhaps they believe, as does the small boy with his drum or the carilloneur with his chimes, that every one loves their particular kind of noise. But if they have or did have this belief, it is merely a class delusion—a class like an individual has its characteristic delusions—and as such it signifies a separation between their own thinking and that of other people which is sure to lead to trouble sooner or later. Is the trouble now at hand? Is the world ready to rise in revolt against the gun, even at the cost of doing away with the rivet and taking the weld to its bosom?

Stray bits of evidence, as cited above, indicate that such a revolt is on the way or already started. If our interpretation of the evidence is correct, and if the movement carries through, we may soon see welding established as superior to riveting for reasons quite unconcerned with cost and efficiency. Such a development would be another instance of how psychological factors may overbalance physical or economic facts, and how human development sometimes hinges on considerations that engineers' calculations usually leave out of account.

Water Sanitation and Recreation

IN CONSIDERING water as a natural resource reference is rarely made to its recreational value. However minor this may be compared with the four important functions of flowing water—power, navigation, irrigation and sanitation—its far-reaching importance is increasing rapidly in numbers of people affected, in money and health values and in the problems which it is creating. A part of the recreational value of our water resources is embraced under one of the four functions mentioned above, if canoeing and other minor forms of boating are included under navigation. In addition, there are such recreational values as bathing and angling, to say nothing of the esthetic values of our running streams, waterfalls, and lakes. All these recreational values on the one hand and all the utilitarian values on the other, are in greater or less degree antagonistic—as are the four great functional utilitarian uses more or less in conflict each with the other.

Just as the two great divisions of use of water for sanitary purposes—water supply and wastes' disposal—are in conflict, so are there conflicts between wastes' disposal and the pleasures of angling, boating and bathing, while all three of the latter, when pursued in fresh waters, may endanger public water supplies. These conflicting interests are multiplied and intensified both by the growth of cities, which sends them always further afield for water and more of it and by artificially hived masses, ever larger and more crowded, who yield to their inborn urge for outdoor recreation and, with the aid of the automobile, rush to the gathering grounds and shores of our municipal water supplies, there to meander, or fish or bathe according to opportunity, inclination and the absence or presence and efficiency of sanitary protection.

Evidently, then, besides the conflicting interests of the four great functional groups—to which might well have been added a fifth, the food fishing industry—are large recreational interests to be conserved and extended on the one hand and on the other to be so controlled that they will not menace the public health by polluting public water supplies. This is no simple matter. The attack should be rational. Contending interests should be weighed and balanced. Sentiment should not outweigh science, or if so, it should be done knowingly and sentiment be made to bear its due part of the expense.

A notable example of the intelligent control, both sanitary and financial, of recreation on inland waters, is afforded by what has been done by the city of San Diego, Calif., in connection with its water-impounding reservoirs, as described by the official in charge on p. 386 of our issue of Sept. 2. In striking contrast is the uncontrolled recreational use of some of the sources of public water supply in New Jersey, though this stricture does not apply to all New Jersey municipalities and does not appear to be reflected in the vital statistics of the communities directly concerned. To the wise, the last-named fact suggests how difficult are the problems of water control and how careful one must be to avoid the hysterical generalizations of that organization which taking the most noted of fishermen as patron saint has forgotten in its love for the beautiful that there may be in this world some need, too, for the useful. There is a happy mean in fighting stream pollution, which remembers the rights of the many as well as the desires of the few.

Architectural Development and the Use of Silicon Steel in the Richmond Power Station

Impressive and Esthetic Appearance a Primary Objective in Planning Philadelphia's Largest Electric Station—Remarkable Steel Arch Roof of Great Turbine Hall—8,000 Tons Silicon Steel Used in Frame

By Frank N. Kneas
Chief Engineer for John T. Windrim, Philadelphia

ON THE right bank of the Delaware River, just below the bridge carrying the seashore line of the Pennsylvania R.R., the Philadelphia Electric Co. has just built its Richmond Station, intended to be a main generating station for the Philadelphia region.

The Greek style of architecture is represented in the treatment of the exterior of the station. An esplanade formed at the base of each of the building units serves to emphasize the scale of the structure. The one at the base of the river façade of the boiler house—that section of the building which is nearest the river—contains the machine shop and at its up-river end covers the ash conveyors, which are at grade level. The esplanade roof is reached by steps from the boiler house operating floor, thus providing an excellent emergency exit in case of any possible accident or panic in the boiler house.

In the turbine hall, with its steel arched roof, an abundance of natural light and air is provided through the large windows at each end and on each side. The construction is such that when the future units are erected (the present structure is only one-third of the

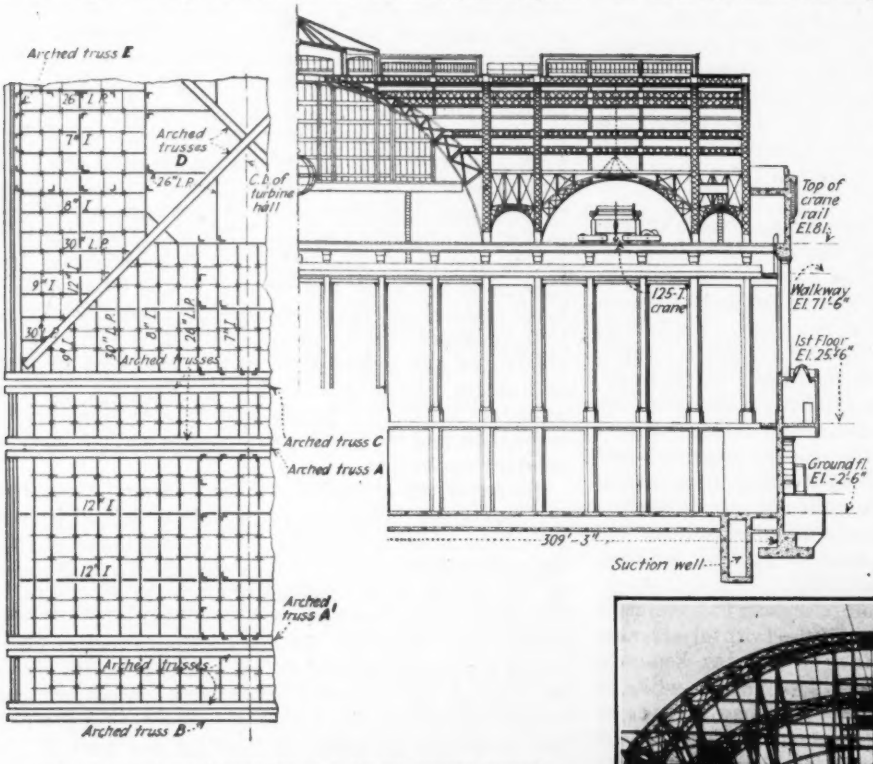


FIG. 1—PART FRAMING PLANS OF TURBINE HOUSE, RICHMOND STATION

In its design, intensive study and thought were given by Dr. W. C. L. Eglin, chief engineer of the company, and his able staff, to producing mechanical and electrical equipment of the most advanced type, for minimum current cost. But at the same time equal emphasis was laid upon impressive and pleasing architectural treatment, in the belief that such a plant should have a monumental effect rather than the bare utilitarian appearance common in power stations. The result of the architect's work expresses quite obviously the heroic scale of the plant. This introduction of architectural ideals into power station design gives the Richmond Station marked distinction.

Structural engineers will also be keenly interested in the fact that the plant is constructed of material not available a short twenty-five years ago. The structure in the main is built of silicon steel and reinforced concrete.

FIG. 2—TURBINE HALL FRAMING OF SILICON STEEL
First large-scale use of this high-strength material.

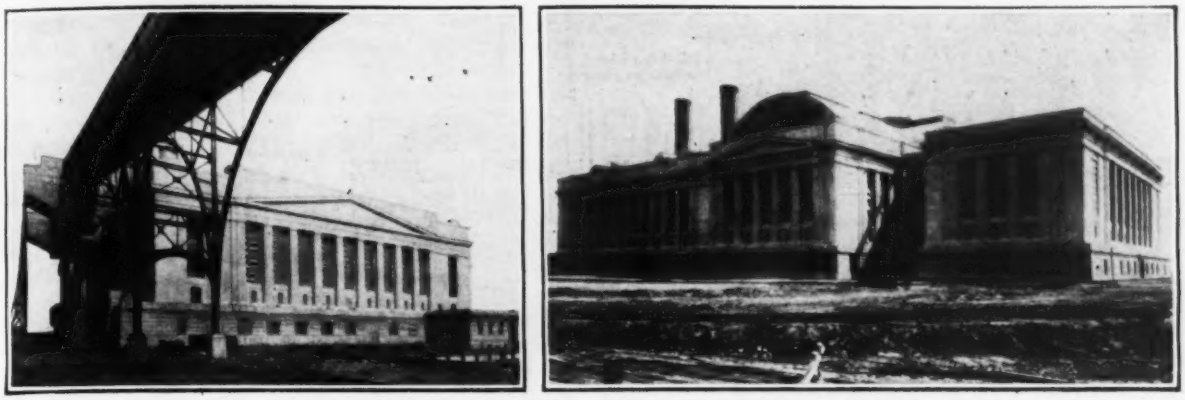


FIG. 3—ARCHITECTURAL DEVELOPMENT OF RICHMOND STATION
River front with the graceful coal conveyor bridge, and main or north façade.

ultimate station) light and air will still be obtained in such full degree as to provide the best of operating conditions.

The interior of the turbine hall is of vast proportions. The steel roof arches were the subject of the architect's most careful study so that every pound of steel would contribute its utmost to the strength of the structure, and do so in the most artistic manner. The result well shows the co-ordination of the work of architect and engineer.

Particular success was attained in making a structure that is usually objectionable and obtrusive into one of light and graceful form—the inclined coal conveyor at the southern corner of the river front. The viaduct carrying this conveyor consists of sweeping steel arches, continuous over four supports, and supported at its two ends (the coal tower and the cross conveyor) by swinging links. The solution of this problem was specially difficult because of the complicating factors of the case: The conveyor is on an incline, one of the four supports is considerably higher than the other three, the arches necessarily are irregular curves, and thus both architectural and engineering questions were unusually complex.

The main structures of the station are founded on spread footings on beds of sand and gravel, at depths from 15 ft. to 30 ft. below grade and water level. The coal tower, however, rests on four hollow concrete boxes constructed on gravel 40 ft. below the level of the Delaware River.

Special Steel—Since a large steel tonnage was involved it appeared possible to get rollings of special steel should such be found desirable. A paper by Dr. George K. Burgess of the Bureau of Standards on the qualities of engineering steels led to an investigation of silicon steel. Some of the elements of the problem were the special difficulties of its manufacture and fabrication, its higher cost per ton, the possibility of its being too brittle under impact or vibration for power house work, and the further fact that the city building code did not directly cover the use of this material. In manufacture, segregation and piping might present special difficulty, calling for watchful inspection and perhaps leading to some rejection. In fabrication the steel would be harder to drill and ream than standard structural steel. Accordingly the cost per ton would run higher. On the other hand, silicon steel promised 40 per cent greater carrying strength.

Therefore, after sample bars of silicon steel had been procured, and bent cold through 180 degrees; after stresses in railroad rails—which are of even harder steel and of course are subject to large impact—had been compared with those in a power house frame; after preliminary cost figures had been obtained, and after the findings had been submitted to the Bureau of Building Inspection, the writer suggested the use of

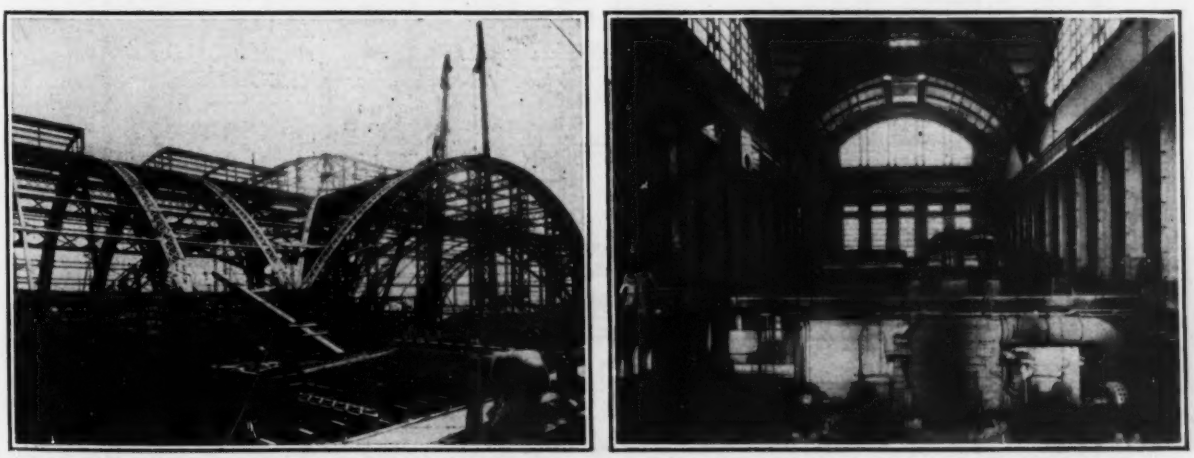
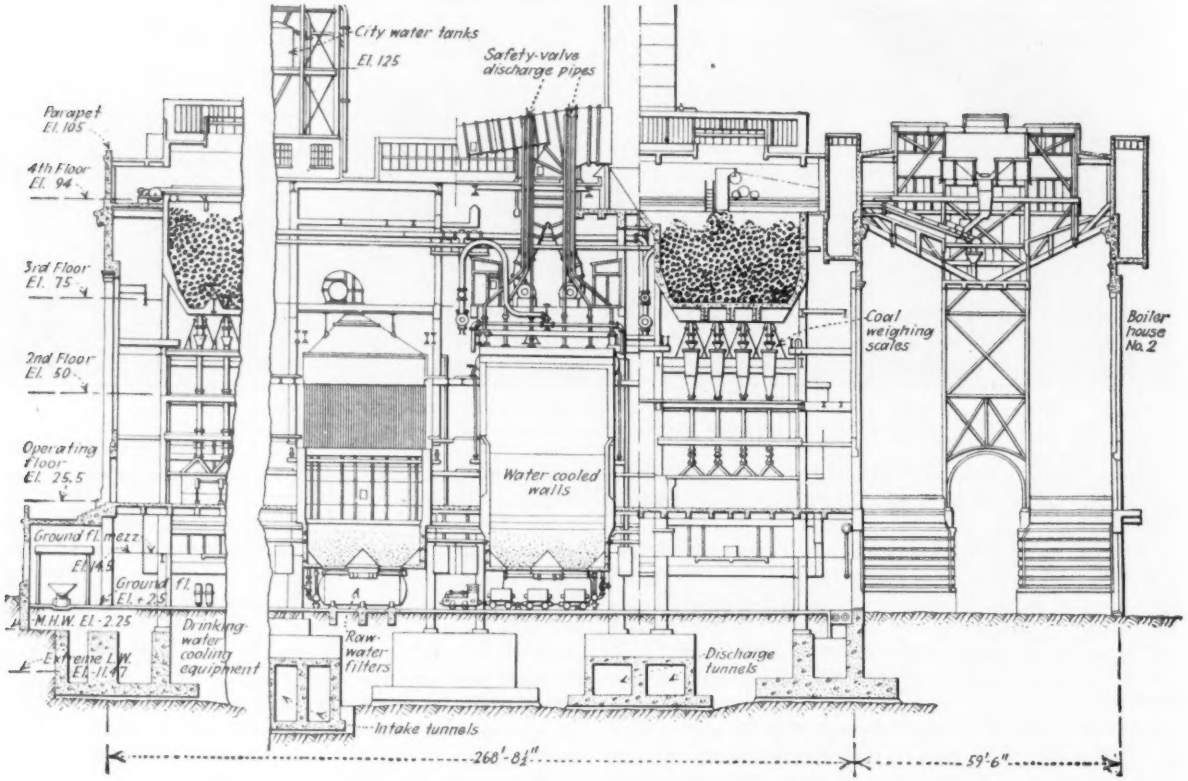


FIG. 4—ARCHED ROOF CONSTRUCTION OF BOILER HOUSE AND OF TURBINE HALL FOR FOUR 60,000-KW. UNITS
The turbine seen in the picture is one of the two middle units; a third unit, not yet installed, is to be placed in line with the balcony projection in the immediate foreground.



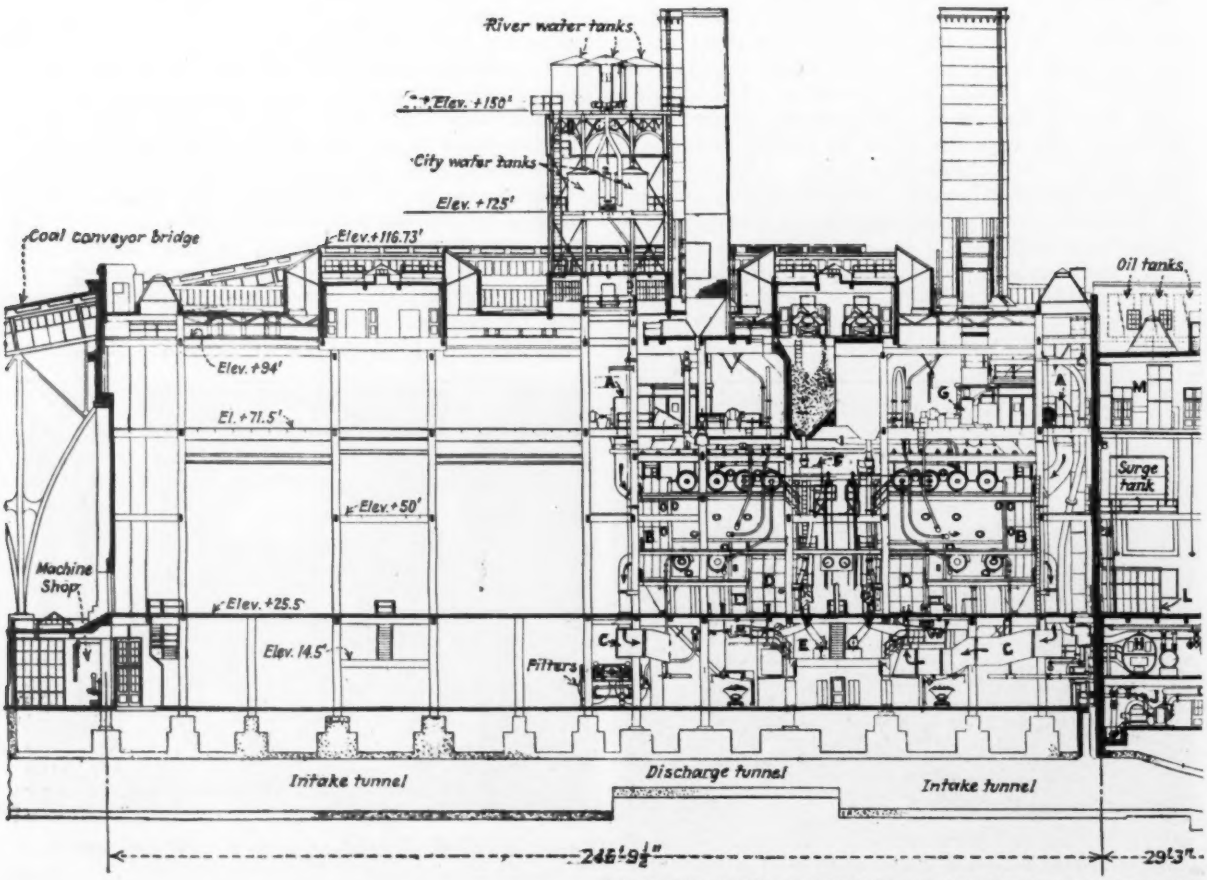


FIG. 5—RELATION OF FRAMING TO EQUIPMENT, AS SHOWN

this material. After thorough review the architect directed its adoption in the design, a decision which was approved by the owners.

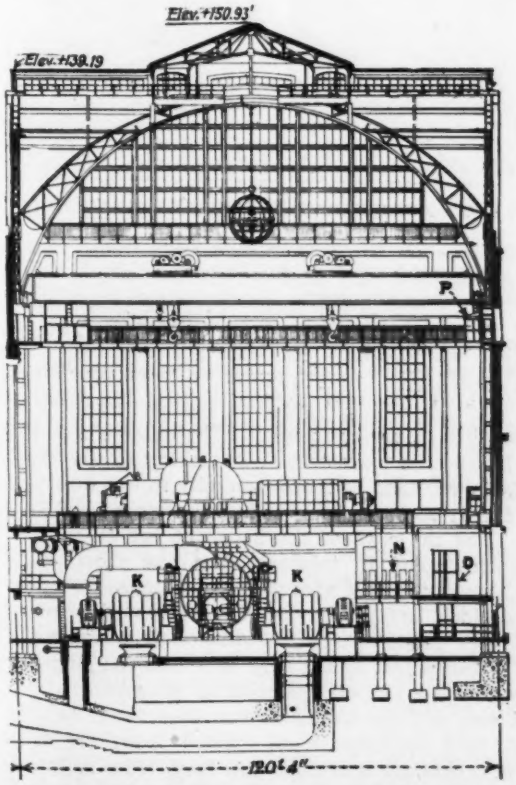
In the switch house, turbine hall and boiler house of the completed section (that is, for the first third of the ultimate station) there is a total of 10,000 tons of steel. Of this, over 8,000 tons are silicon steel, while the remainder is standard carbon steel. Another 1,000 tons of standard structural steel is consumed in the coal tower and the conveyor bridge. Thus the total framework of the present station comprises 11,000 tons.

The silicon steel includes all of the main members of the main building framework except the framing of the turbine hall roof. The connection angles, fittings and walkway channels, curb angles and miscellaneous material are all carbon steel, however. The crane runway, as well as the columns and gallery framing in the turbine hall, are of silicon steel.

In the boiler house, the use of silicon steel was a great advantage, allowing the sizes of the columns to be kept down, which was advantageous with respect to boiler clearances and aisle spaces. It permitted using beams of smaller depth, and in some cases rolled sections in place of plate girders. The estimated saving due to the use of silicon steel amounted to $150,000.

Test Data—The main requirements of the specifications as to chemical and physical properties of the silicon steel are noted below, with a parallel column showing the actual qualities obtained in an average of 65 heats.

To exhibit the range in test values obtained in the entire tonnage of material used, Table II has been compiled, giving the results from the five heats showing lowest ultimate strength, the five showing average ultimate strength, and the five showing the highest ultimate strength. The maximum and minimum values of each quality are shown in bold type.



BY SECTIONS OF BOILER AND TURBINE HOUSES

TABLE I.—SPECIFICATIONS, REQUIREMENTS AND TEST RESULTS FOR SILICON STEEL

	Specified Values Per Cent	Test Values (Average of 65 Heats) Per Cent
Carbon	Max. 0.40	0.353
Silicon	Min. 0.15	0.275
Manganese	Max. 1.00	0.761
Sulphur	Max. 0.05	0.038
Phosphorus	Max. 0.04	0.018
Tensile strength	80,000–95,000 lb. per sq.in.,	85,860 lb. per sq.in.
Elongation, per cent in 8 in.	$\frac{1{,}500{,}000}{\text{tens. strength}}$ or about 17.5 per cent	21.38 per cent

For bend tests it was required in the specifications that a specimen shall bend cold through 180 deg. without cracking on the outside around a diameter equal to thickness, for material $\frac{3}{4}$ in. or under in thickness; and around a diameter of twice the thickness, for material above $\frac{3}{4}$ in. and up to and including $1\frac{1}{4}$ in. These requirements were fully met. Sheared or burned cuts in material over $\frac{5}{8}$ in. thick were required to have the edges planed or chipped. All holes were required to be sub-punched and reamed.

Effect of Punching Tested—During the progress of the work comparative tensile tests were made on bars with holes in the center to determine the effect of sub-

TABLE II.—RANGE OF TEST RESULTS ON SILICON STEEL

Yield Point, Lb. per Sq.In.	Ult. Str., Lb. per Sq.In.	Elong., per Cent	Rad. of Area, Per Cent	Chemical Composition, Per Cent C	P	Mn	S	Si
Five heats of lowest ultimate strength								
49480	**80160**	23.00	46.30	.33	.026	.74	**.047**	.28
41530	80240	23.70	43.40	.32	.022	.74	.035	.30
50860	80400	**24.50**	**56.60**	.31	.022	.79	.045	.28
47230	80600	22.50	44.10	.33	.015	.68	.033	.30
48160	80680	23.00	45.00	.32	.024	.74	.033	.29
Five heats of average ultimate strength								
53100	85900	20.70	46.20	.33	.023	.76	.035	.30
53060	86000	20.00	44.30	.34	.021	.77	.037	.27
48720	86160	22.50	41.50	.39	**.011**	.82	**.019**	.19
50000	85500	21.00	39.70	.35	.020	.75	.036	.29
51700	86400	22.20	42.90	.35	.021	.72	.032	.27
Five heats of highest ultimate strength								
50840	**92710**	18.40	**32.90**	.39	.011	.82	.032	.18
52960	93020	19.60	44.70	.38	**.029**	.85	.040	.28
50620	93440	18.70	38.20	.39	.014	.90	.045	**.33**
52220	93480	**18.20**	36.30	.39	.014	**.90**	.045	.33
48800	**94140**	18.70	44.90	.39	.013	.84	.034	**.15**

Effect of punching and reaming. A long bar of silicon steel of cross-section $3\frac{1}{2}$x$3\frac{1}{2}$ in. was cut into test pieces about 18 in. long. One set of six alternate pieces was punched with a punch $\frac{13}{16}$ in. in diameter over a die $\frac{15}{16}$ in. in diameter, and reamed to $\frac{15}{16}$ in. The other set of six pieces was punched with a $\frac{7}{8}$-in. punch over a $\frac{7}{8}$-in. die and reamed to $\frac{15}{16}$ in. Each piece of one type was taken from the bar adjacent to one of the other types. If the strength of the bar varied slightly throughout its length, even then the average of the six would be representative for each type. One piece was also punched $\frac{15}{16}$ in. without any reaming.

In addition to these tests and in order to show how much abuse this silicon steel would stand in drifting, one test piece had a hole punched $\frac{1}{2}$ in. and then enlarged cold to $1\frac{1}{4}$ in. by driving into the hole a tapered pin similar to a drift pin. In all of these tensile tests a pin was fitted into each hole just before the bar was pulled. This was to represent the conditions that would occur in practice and to prevent the squeezing in of the hole as the bar stretched under the tension.

The average strength of the six bars punched $\frac{13}{16}$ in. and reamed to $\frac{15}{16}$ in. was 99 per cent as high as the average for the six that had been punched $\frac{3}{4}$ in. and reamed to $\frac{15}{16}$ in. The average was 82,490 lb. per sq.in. for the first case and 83,180 lb. per sq.in. for the second. The variation of the individual bars from the average was about 3 per cent. The one bar punched $\frac{13}{16}$ in. diameter without reaming showed 77,040 lb. per sq.in. One test alone cannot show anything very conclusively, but this one did not contradict the accepted view that sub-punching and reaming is better than punching full-size. The bar that had a hole punched $\frac{13}{16}$ in. and drifted to $1\frac{7}{8}$ in. showed in spite of its harsh treatment a surprisingly high result of 75,740 lb. per sq.in., based on the net section before drifting. The drifting piled up the metal around the edge of the hole, although, of course, the bar was also stretched lengthwise by the drifting and therefore had probably a slightly smaller cross-section than assumed. The result given is therefore too low rather than too high.

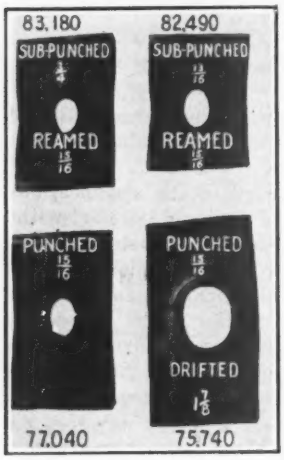


FIG. 6—TENSION TESTS ON PERFORATED PIECES OF SILICON STEEL PLATES

The ends of four representative test pieces fitted together are shown in Fig. 8. Curiously enough there is in each case a gap of $\frac{1}{8}$ in. at the inner edges of the sides of the holes, indicating that the failure started at the sides of the holes and the tear traveled to the outer edge of the bars. The outer edges of the bars seemed to hold on to the last, with the most stretch. It is interesting to compare these results with the theoretical stresses in tension bars with central holes. George F. Swain, LL.D., in his book on "Strength of Materials," 1924, pp. *et seq.*, gives a résumé of theories on this point.

Effect of Impact—As a check on the impact resistance of the silicon steel, a full-sized beam 18 in. deep, 20 ft. long was subjected to an impact test, the impact being perpendicular to the web and sufficiently severe to bend the beam 2 ft. out of line. The beam was then straightened without heating and test strips about $\frac{5}{8}$ in. wide were cut from the edges of the flanges where the bending had been most severe; comparison strips were cut from the ends of the beams where there had been no bending.

It is obvious that if any incipient cracks, even of microscopic size, had been started, or if any injury had been caused on the edges of the flange by the bending and straightening, the test pieces would show low results. But the test pieces cut from the point of maximum bending were as strong as those taken from the ends of the beams—averages of 81,250 and 81,350 lb. per sq.in. respectively. Portions of these pieces were later examined under a metallurgical microscope and several micrographs are shown.

Most of us have been accustomed to consider wrought iron a fibrous material. The same idea seems to have been carried over to structural steel for we speak in our mechanics of materials of the extreme fibers, fiber stresses, etc. But if a piece, even of wrought iron, is cut parallel to the so-called fibers and magnified to 100 diameters, it will be seen that the iron is made up of irregularly shaped crystalline grains, whose axes average as long in one direction as in any other. They have not even been elongated by the squeezing and the rolling as the grains form mainly during the cooling after the rolling. They are of the same general appearance in the longitudinal section as in the cross-section. The fibrous appearance of the iron is due to particles of slag being elongated and even these particles or threads are found to be granular when examined under higher magnification.

Soft steel has the same crystalline grain structure with few slag particles. When steel contains carbon, grains of two types appear—one light and one of a dark pearly appearance like mother-of-pearl. The light grains are ferrite, almost pure iron; the dark are pearlite. The latter are found under higher magnification to be of laminated structure, the laminations being about 1/25,000 in. thick, of ferrite and cementite alternating. Cementite is carbide of iron.

In Fig. 8 two micrographs are shown of silicon steel. The one shows a typical structure, the axes of the grains lying in various angles. The other shows that there had been a movement or stretching of the grains and their long axes lie more generally in one direction. Both are from one of the test pieces which had been taken from the edge of the flange of the 18-in. beam and pulled apart in tension. The one showing the typical structure with axes at various angles was about half an inch back from the edge of the piece where it had been pulled apart. The other with the distorted grain is taken just at the very edge and the long axes of the grains lie in the direction of the pull.

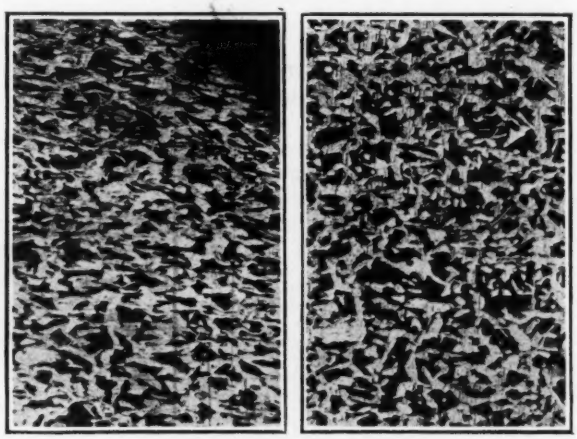


FIG. 7—TWO MICROGRAPHS OF THE STRUCTURE OF SILICON STEEL

White areas are ferrite, black areas are pearlite. Both pieces are from a tensile test specimen taken from the edge of the flange of an 18-in. beam, and photographed after this specimen was pulled apart. The direction of the tensile strain was horizontal with respect to the two photographs. The left-hand view was taken at the very edge of the fracture, and shows grains elongated in the direction of the tension. The right-hand view, taken $\frac{1}{2}$ in. back from the edge of the fracture, shows undistorted or random direction of the grains.

Not only did the use of silicon steel prove successful but the buildings were erected in record time. General excavation was started in May, 1924. The first steel was erected January, 1925. The station was put into actual operation November, 1925.

Organization—The plant was designed and erected by the Philadelphia Electric Co., Dr. W. C. L. Eglin vice-president and chief engineer. John T. Windrim was the architect. The structural steel was furnished by the American Bridge Co. The steel was erected and the buildings were constructed by Stone & Webster, Inc. Alexander Wilson III was construction engineer for the Philadelphia Electric Co., under whose supervision the station was erected and equipment installed.

Ore-Dock Reconstruction on Two Different Designs

All-Concrete and Combined Concrete and Steel Docks—Details of Concrete Design of Northern Pacific Ry.

RADICALLY different designs for similar structures, built in the same place and for the same purpose, are exemplified in the reconstruction of ore-shipping docks at Superior, Wis. The Northern Pacific Ry. has adopted an all-concrete design, including both poured and precast portions. The Great Northern Ry., on the other hand, has adopted structural steel framing in combination with poured and precast concrete. For the former, the all-concrete design was adopted, after a consideration of various types, as being cheaper in construction and requiring little maintenance. In the latter case, the combination of steel and concrete, as compared with an all-concrete structure, was considered to give greater facility of erection, lower first cost and a reduction of about 10 per cent in weight above the foundation piling.

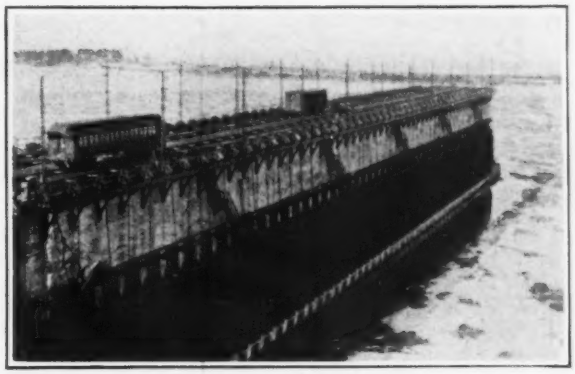


FIG. 1—ORE DOCK OF NORTHERN PACIFIC RY.

A concrete pier forms the substructure in each case, but while the first mentioned design employs a foundation of sand-filled cribs with interior piling, the latter employs piling alone. The Northern Pacific Ry. ore dock, built entirely of concrete and having a pile and crib foundation, is described below. A later article will describe the steel and concrete design of the Great Northern Ry. dock.

General Design—For shipping ore at Superior, Wis., the Northern Pacific Ry. has a dock or pier which was formerly 1,212 ft. long, with 202 pockets of 350 tons capacity, giving a total storage of 70,700 tons. This dock, of which 102 pockets were built in 1913 and 100 in 1917, proved inadequate for the increased traffic. In 1925-1926, therefore, an extension of 648 ft. was added, having 108 pockets and increasing the total ore storage capacity to 108,500 tons. The height is 80 ft. from water level to base of rail and 42 ft. 4 in. to the low point of the pockets. Its width is 59 ft. over the pockets and about 66 ft. over the deck. This completed extension is shown in Fig. 1, from a view taken March 23, 1926.

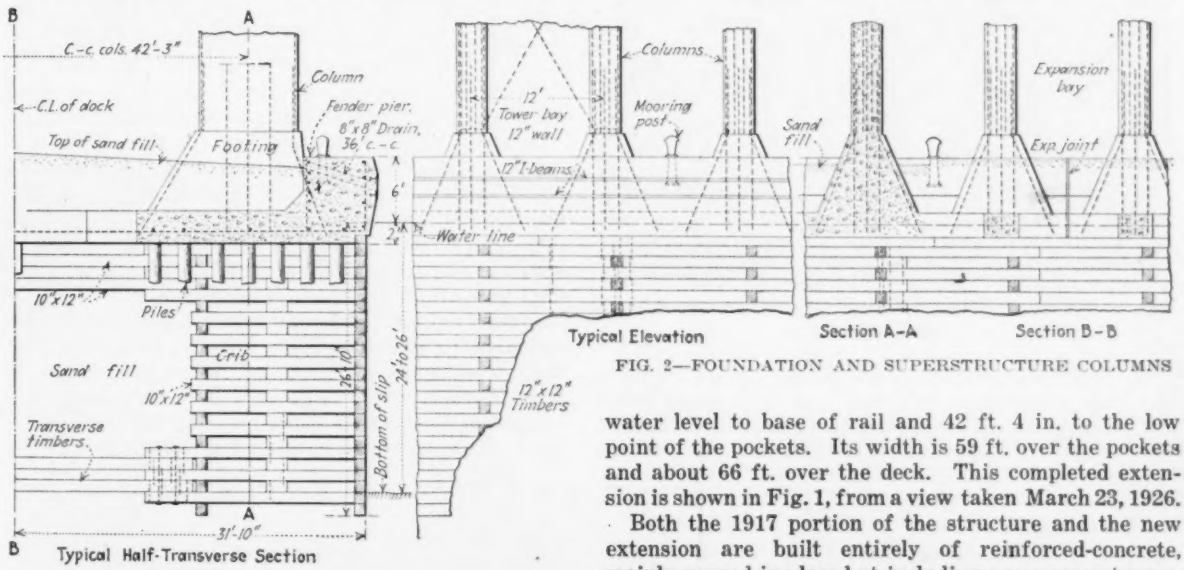


FIG. 2—FOUNDATION AND SUPERSTRUCTURE COLUMNS

Both the 1917 portion of the structure and the new extension are built entirely of reinforced-concrete, mainly poured in place but including some precast members. This type of construction was adopted, after a consideration of various types, as being cheaper in construction and requiring very little maintenance.

Substructure—A pier about 65 ft. wide, with concrete deck, forming the base of the ore dock, consists of two lines of timber cribs 16 ft. wide and 26 ft. high, sunk about 5 ft. into the sand at the bottom of the slips and each having a solid outer wall. These two lines of cribs are connected by long transverse timbers at top and bottom, and piles are driven within and between the cribs, as shown in Fig. 2. Sand was pumped into the cribs and the inclosed space between them. This work was done in two operations, the bottom 10 ft. of fill being placed first, in order to anchor the cribs so that the piling could be driven; the balance was then placed after driving the piles. These 65- and 70-ft. piles were cut off level with the top of cribbing, at 12 in. below low-water line.

After the sand had been leveled off at 2 ft. below water level, a reinforced-concrete slab was poured upon

it, 36 in. thick, extending the full width of the pier but having central openings at intervals to reduce the amount of concrete. This construction is shown in Fig. 3. On top of this slab the side fender wall, nose at end of dock and column pedestals were poured. The

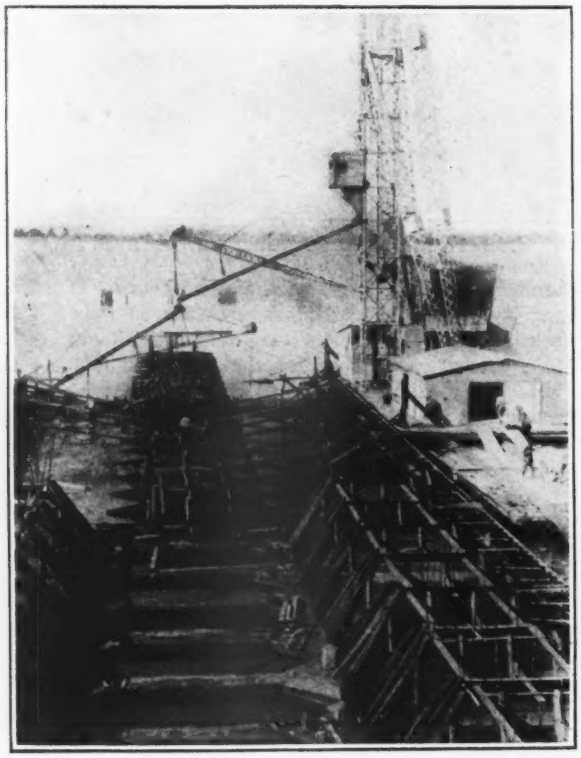


FIG. 3—CONCRETING PIER DECK AND COLUMN FOOTINGS (JULY 18, 1925)

sides of the slab and fender are carried up to 6 ft. above the water, forming a dock wall 6 ft. wide, along which the mooring or snubbing posts are anchored. The face of the wall is convex, with two lines of 12-in. I-beams embedded in it as a fender protection when steamers come alongside. Upon the slab is sand filling level with the fender walls. The slab and walls are in lengths of 120 ft., separated by 1½-in. joints packed with tarred paper-board.

Superstructure — Pedestal footings poured integrally with the fender walls, as in Figs. 2 and 3, support two rows of rectangular columns 3x9 ft., spaced 12 ft. c. to c. and connected by longitudinal beams or struts and by transverse precast tie-beams. In the bays at the expansion points the longitudinal struts are omitted, while the middle bay of each 120-ft. length is formed as a tower or braced bay by means of a 12-in. curtain wall having

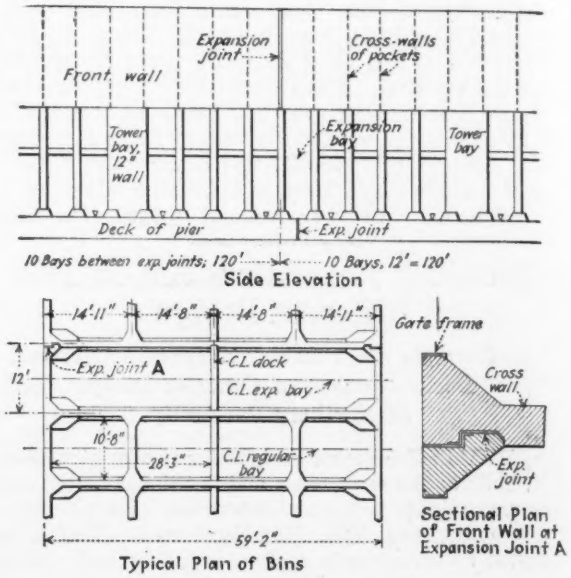


FIG. 4—TYPICAL ELEVATION AND PLAN

diagonal reinforcement. This arrangement is shown in Fig. 4. Transversely, the piers are 42 ft. 3 in. c. to c.

From the cross-section, Fig. 7, it will be seen that upon each pair of columns is a vertical 16-in. transverse wall, separating the bins, and between these walls is the inclined slab of the bin bottoms, having a slope of 42 deg. 35 min. The front wall is 10 in. thick. A 12-in. longitudinal wall, which divides the bins, extends along the center of the dock at the apex of the sloping bottoms. There is also a longitudinal strut at the center of each bin, extending along the tops of the pockets.

Across the tops of the pockets are laid I-beam track stringers, on which the 90-lb. rails are secured by riveting. Transverse and diagonal members complete the deck framing, which is covered by a 4-in. plank floor, except for the narrow space between the rails of each track. Lamp posts 60 ft. apart support transverse wires

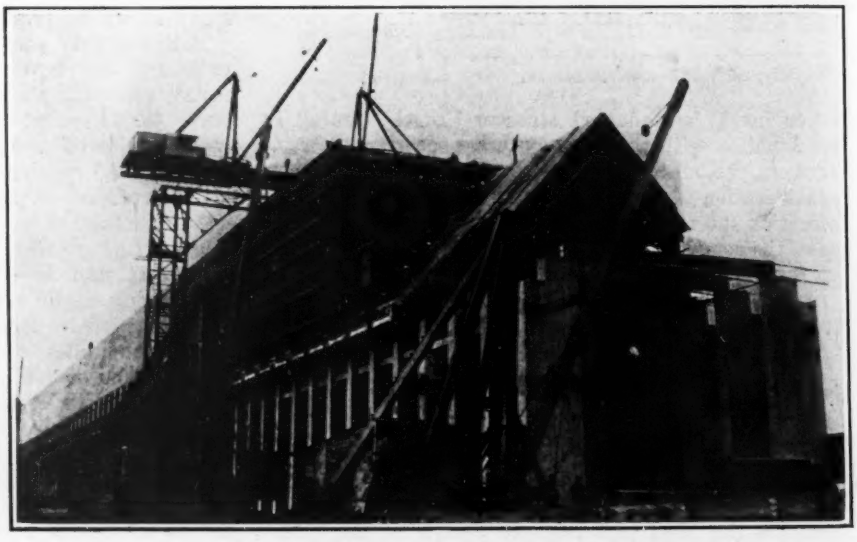


FIG. 5—CONSTRUCTION WORK ON ORE DOCK

Gantry carries two traveling derricks. Note trussed forms under sloping bottom of pockets. These forms were handled by a derrick on a track carried by the precast tie-beams resting on the columns. View taken Oct. 22, 1925.

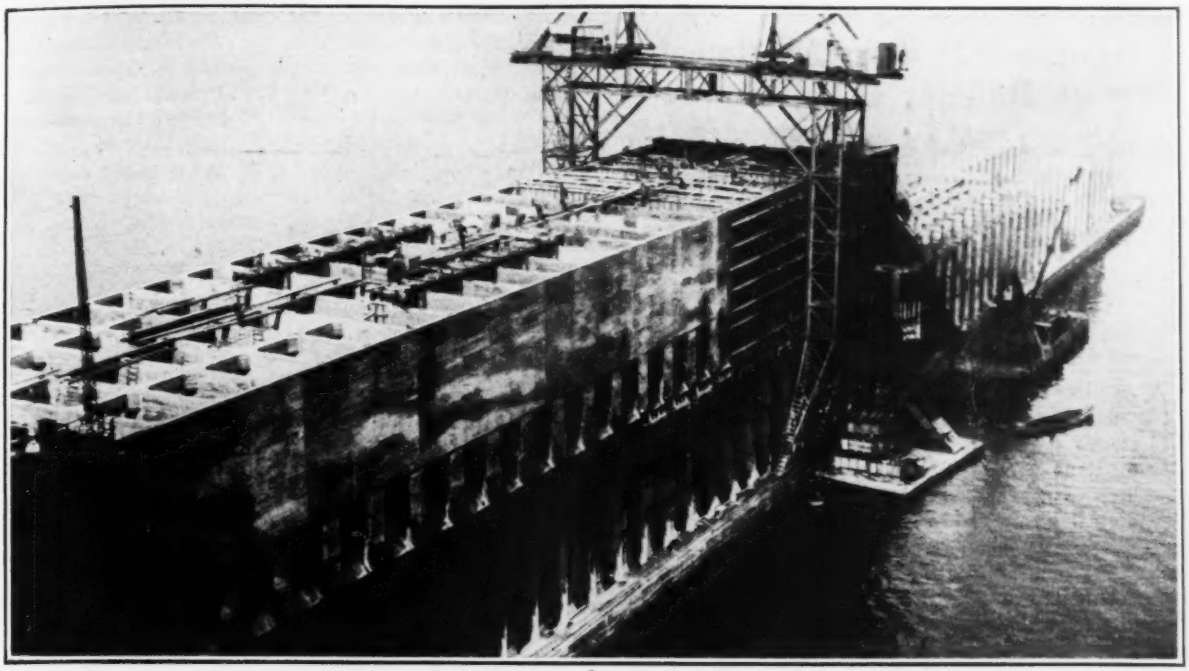


FIG. 6—PROGRESS VIEW OF ORE DOCK (OCT. 1, 1925)
Gantry with derricks travels on fender walls of pier. Completed pockets at left. Forms in place at gantry. Pier deck and columns at right.

from which are suspended five 200-watt electric lamps with steel reflectors over them.

Each pocket has in the front wall a discharge opening 7 ft. wide and 4½ ft. high, fitted with a fixed steel chute to deliver the ore into the 34-ft. spout. The vertically sliding gate and hinged spout of each pocket are operated by means of an individual hoist with electric motor.

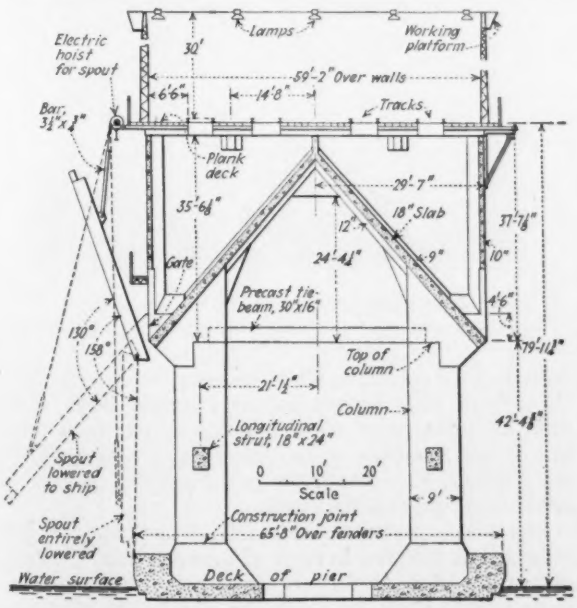


FIG. 7—ORE BINS AND TRACK DECK

The deck is designed for Cooper's E-60 loading, with 50 per cent of the A.R.E.A. allowance for impact. Dock locomotives weighing about 132 tons take trains of 38 cars of 35 to 60 tons load capacity.

Construction Methods—In the construction of this dock superstructure, the footings were poured as integral parts of the deck slab of the pier, as in Fig. 3. Then the columns were poured separately to a height of 42 ft. above the water, the longitudinal struts and the curtain walls of tower bays being formed monolithically with the columns. Precast transverse tie beams were then placed upon the columns and grouted in position; these were utilized to support the forms for front walls, bottom and cross walls of pockets.

In pouring the concrete for the pockets, each 120-ft. length between expansion joints with 20 pockets, was completed in three sections; first section, seven pockets, 510 cu.yd. of concrete; second section, six pockets, 467 cu.yd.; third section, seven pockets, 602 cu.yd. This concreting was begun Sept. 10 and completed Nov. 3, 1925, or 54 days for the 108 pockets.

Forms for the pockets consisted of a collapsible bottom or under form, an outside face form and an adjustable inside form. These are shown in Figs. 5 and 6. They were all composed of timber facing on steel frames. They were handled by a gasoline-driven derrick mounted on an overhead traveler which moved back and forth along rails laid upon the concrete fenders or dock walls (see Fig. 6). The under forms for sloping bottoms of pockets, Fig. 5, were handled by a special machine which lowered them, moved them ahead to a new location and then set them in place. This machine traveled on rails laid across the transverse tie beams.

Engineers and Contractors—This reinforced-concrete ore dock was designed and built under the direction of H. E. Stevens, chief engineer of the Northern Pacific Ry., and M. F. Clements, bridge engineer. The general contractors were Peppard & Fulton, Superior, Wis., and Foley Brothers, St. Paul, Minn. Work on this 648-ft. extension was begun April 14, 1925, and was completed Feb. 8, 1926, except for the electrical equipment and adjustment of the hoists. The dock was ready for service on opening of navigation in April.

Concrete 19-Story Apartment Building at Detroit

Frame Independent of Room Layout—Special Wind Bracing—Concrete Mix Varies—Design, Construction and Cost

By William F. Zabriskie
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and W. S. Wolfe
Head of Structural Department, Smith, Hinchman & Grylls, Detroit; Formerly Chief Engineer, Gabriel Steel Co.

A REINFORCED-CONCRETE building which is notable for its height and for several features in its structural design is the Detroit Towers apartment building, at Detroit, Mich., which is a nineteen-story building with brick curtain walls and a wood pile foundation. It has a ground floor approximately at grade, a mezzanine floor and seventeen floors of two apartments each. The building is irregular in plan and has therefore some unusual design in the spandrel beams and the interior framing. The architect recognized the fact that, owing to the height, the columns would be of large section, and he therefore laid out his plan in such a way that many of the columns come in closets or in other places where their size is neither objectionable nor very noticeable.

This building, shown in Fig. 1, is about 105 ft. in length, with a frontage of 44 ft. on the street and 60 ft. on the bank of the Detroit River. Each story has a floor area of about 5,400 sq.ft. Piles 35 to 45 ft. long were driven through fill and gravel into a clay formation and were cut off approximately at the water line. They are grouped under the column footings and were assumed to have a load capacity of 20 tons each. The story height is 10½ ft. from floor to floor, except for 11 ft. in the first and second stories; with a clear headroom, from finished floor to ceiling, of 9 ft. 7 in. in these first two stories and 9 ft. 1 in. in the upper stories.

Unusual Structural Features—This building is of special interest to engineers because of the various unusual structural features. In the first place the building is tall and slender, making an unusual wind bracing problem for a concrete building. The wind bracing is further complicated by the irregular plan, the desire to keep the interior beams as small as possible and the requirement that the spandrels be flush with the inside of the 13-in. wall.

In certain parts of the building the beams were not allowed to project below the ceiling. To meet this requirement a deep steel-tile and joist construction was used, with wide beams the same depth as the joists. The circular bay and the broken spandrels are added points of interest. Some of the heavy framing, with deep spandrels, is shown in Fig. 2, while Fig. 3 is a general structural plan.

The computations indicated that the uplift due to the wind might exceed the dead-load for two or three of the columns. These columns were therefore anchored to the pile capping below them by means of the reinforcing steel and the pile capping in turn was anchored to the piles. A heavy concrete foundation wall was used, well reinforced and thoroughly doweled to the pile capping and columns.

The shear in some of the columns ran very high, due to conditions of wind pressure. To reinforce for this, heavy ties were used, in some cases as large as ⅞-in. rods. In many of the lower spandrels the moment from the wind was much higher than from the dead- and live-loads. It seemed desirable, therefore, to omit the ordinary bent beam bars and to use straight bars continuous in the bottom and other straight bars continuous in the top, with additional straight bars top and bottom at the columns. When necessary to develop them, these bars were hooked at the columns, large semi-circular hooks being used in many cases. In a number of the spandrels a uniform spacing was used for the stirrups, since the shear in a beam due to wind is uniform throughout its length.

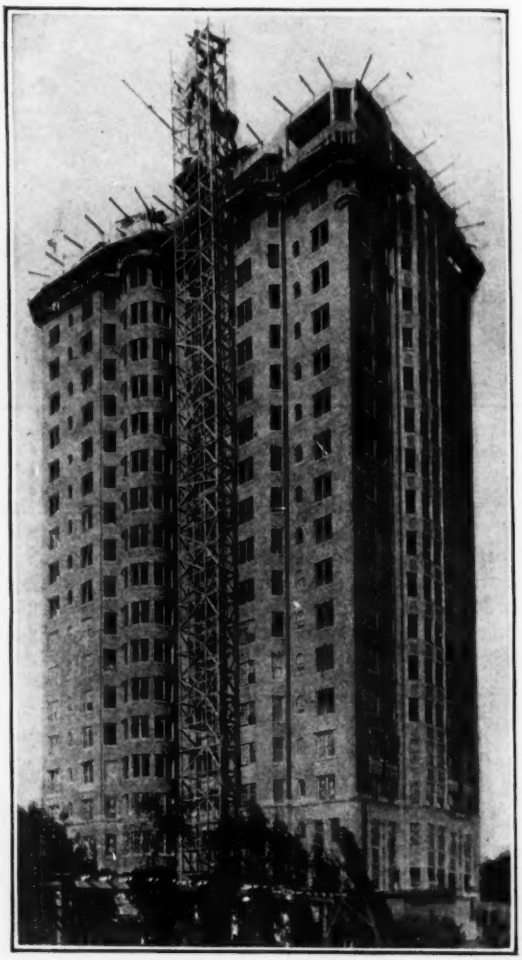

FIG. 1—DETROIT TOWERS APARTMENT BUILDING
Concrete frame, nineteen stories. On bank of Detroit River.

The framing elevations in Fig. 5 indicate the distribution of the steel in some of the spandrels. In fact, one of the reasons for drawing these framing elevations was to show clearly to the men in the field how the steel in the spandrels was to be placed. For a number of the columns it was necessary that the bars be placed in a certain way in order to develop the required resistance to bending about one of the axes. For such cases, the contractor was supplied with a sketch showing the location of each column bar. In some cases

there were four large bars in the top of an 8½-in. spandrel and it was necessary to run these bars through a column having fourteen or more 1¼-in. square bars. It required considerable thought to get all of these bars in their proper places conveniently.

The story heights are low and many of the spandrels

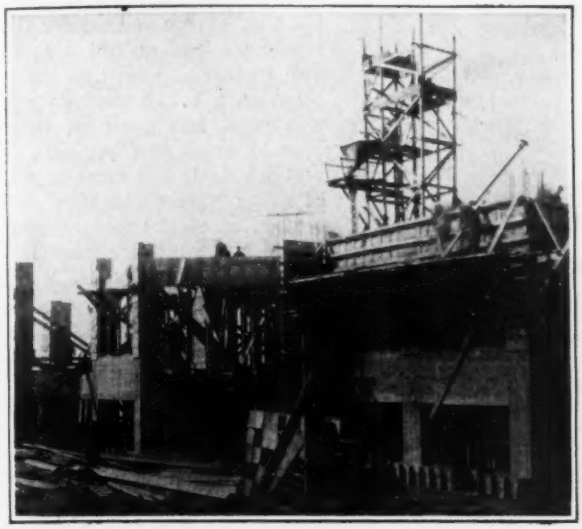

FIG. 2—HEAVY SPANDRELS AS WIND BRACING

are deep, extending both above and below the floor. It therefore seemed undesirable to have 1:1:2 concrete for that portion of the column between spandrels and 1:2:4 concrete for the part of the column throughout the depth of the spandrels. In some of the more critical places, therefore, 1:1½:3 concrete was used for the spandrels, the columns throughout the depth of the spandrels and the adjoining floor construction.

Assumptions and Design — The working stresses, reduction of live-load and other governing conditions were as prescribed by the building code of the city of Detroit. The permissible tensile stress for rods of

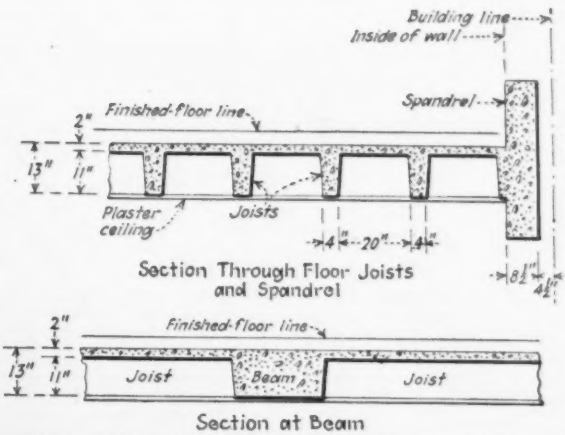

FIG. 4—FLOOR AND SHALLOW BEAM CONSTRUCTION

intermediate grade billet steel is 20,000 lb. per square inch. Maximum compressive stress for concrete is 675 lb. in stayed columns and 750 lb. for 1:2:4 concrete in flexure. The allowable stress for columns was increased 20 per cent when more than one-sixth of the stress was produced by bending, and a 35 per cent increase in the working stress was allowed for wind. The assumptions regarding the distribution of the resistance to wind required considerable thought. The bracing across the building was designed for the following assumptions, the lines of resistance being indicated in Fig. 3: 30 per cent of the wind to be resisted along line *A-A*, 15 per cent along

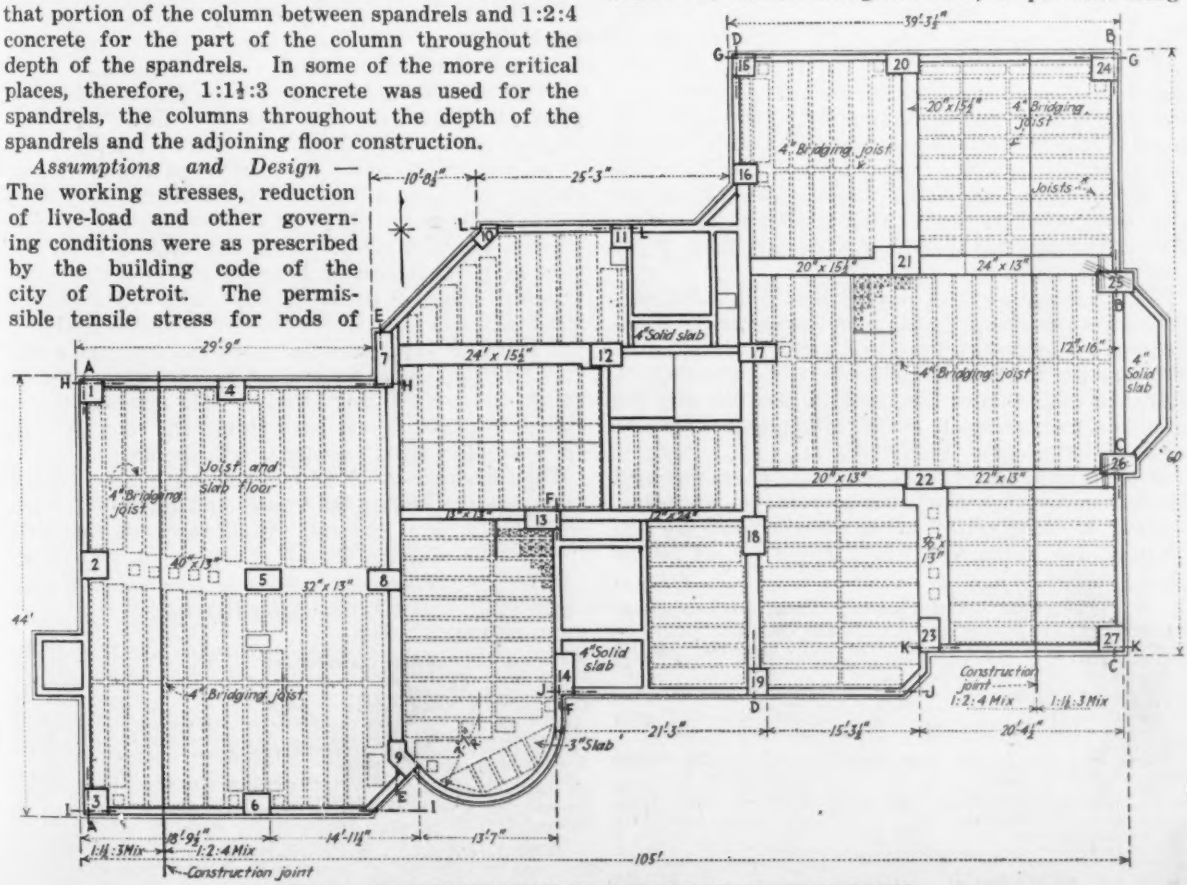

FIG. 3—STRUCTURAL PLAN OF 19-STORY CONCRETE BUILDING

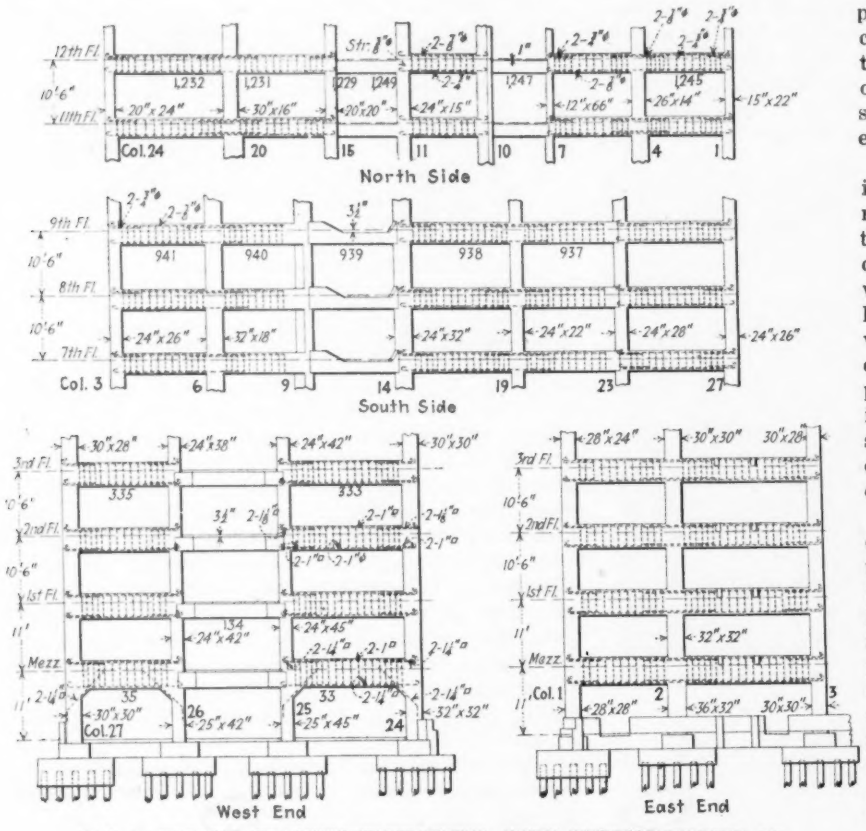

FIG. 5—TYPICAL FRAMING ELEVATIONS; WITH REINFORCEMENT OF SPANDREL GIRDERS

line *B-B*, 15 per cent along line *C-C*, 20 per cent along line *D-D*, 10 per cent along line *E-E*, 5 per cent along line *F-F*, and the remaining 5 per cent by joists, columns and beams along other lines. In the other direction, 25 per cent was assumed taken along line *G-G*, 25 per cent along *H-H*, 15 per cent along *I-I* and also along *J-J*, 12 per cent along *K-K* and the remaining 8 per cent along line *L-L*.

With this assumed distribution of a 20-lb. wind load, the stresses produced by the wind in the various members were computed and combined with the stresses produced by the dead- and live-loads. The connections of beams to columns were designed to take not only the wind load moment but in addition the negative moment produced by the dead- and live-loads.

In the column design, the same cross-section was used for four stories, then a rather large reduction was made, followed by four more stories without changing the concrete size. This idea was followed out as far as practical through the job, at the contractor's request, in order to make more easy the re-use of forms. It worked out very satisfactory in the field during erection.

One of the largest columns is 33 in. square and carries the maximum load of 574 tons to the footing. For the lower columns, a 1:1:2 concrete mix was used, and many of them have as much as 4 per cent of vertical steel, this combination of rich concrete and high proportion of steel being adopted in order to minimize the cross-sectional size of columns. Many of these were designed as tied columns.

Stirrup spacing in the spandrels is mainly 15 or 16 in. for the middle half of the span and 12 in. for the end quarters. But in the bay between columns 6 and 9, the spacing is 12 in. for $\frac{3}{8}$ of the span from column 6 and then 15 in. to the end of the span, on account of the higher shear near column 6. In the bay 1 to 2, also, there is a uniform spacing of 15 in. for the entire length of span on account of the shear being almost uniform.

Floor Design—To insure a minimum dead-load of floor, the joist and slab type of construction was adopted, with a 13-in. depth made up of a 2-in. slab and 11-in. joists. Many of the floorbeams are wide and shallow, having a depth of 13 in. so as not to project below the joists. This feature, shown in Fig. 4, was adopted to avoid visible beams and thus to allow the room layout to be arranged regardless of the structural framing. Beneath the joists and beams is a ceiling of metal lath and plaster. To further limit the dead-load and therefore the sizes of columns and footings, a filling of mineral wood was used between the sleepers upon which the finished floor is laid. This material serves also as a fire stop and noise deadener. The sleepers are secured to metal anchors cast in the floor slab.

The spandrels are all 8½ in. wide, which allows for a 4½-in. brick veneer on the outside and keeps them flush with the inside of the wall. In all cases the spandrels form lintels over the window openings. A number of

COST ESTIMATE FOR DETROIT TOWERS BUILDING WITH STEEL FRAME AND CONCRETE FRAME

A. CONCRETE FRAME DESIGN (AS CONSTRUCTED)

Piling			$12,500
Pile capping, 484 cu.yd., including excavation and forms			9,500
Column concrete:			
1:1:2	617 cu.yd.	$11.50	$7,095.50
1:1½:3	222 cu.yd.	10.50	2,331.00
1:2:4	38 cu.yd.	9.00	342.00
			9,768
Column forms:			
24,000 sq.ft.		$0.25	6,000
Floor and beam construction:			
2,621 cu.yd.			24,995
Floor and beam forms, including removable steel tile			25,200
Reinforcing steel, including engineering			27,450
Placing reinforcing steel:			
370 tons at $15.00			5,725
Total concrete: 3,992 cu.yd.			$121,138

B. STEEL FRAME DESIGN

Piling	$11,800
Pile capping, including excavating and forms	8,900
Column fireproofing: 1:2:4	
434 cu.yd., $9.00	3,906
Column forms: including brackets for wind bracing,	
18,000 at $0.25	4,500
Floor concrete and beam fireproofing	24,995
Floor and beam forms, including removable steel tile	23,800
Structural steel, including erection,	
900 tons at $90	81,000
Reinforcing steel: 100 tons	6,800
Setting reinforcing steel; at $15	1,500
Engineering design	4,000
Total	$171,201

them also extend above the floor, especially in the lower stories, the deepest spandrels being 52 in. These deep spandrls were of great assistance in taking care of the wind stress.

Construction—Rapid progress was made in the erection of this building. The first piles were driven March 1, 1925, and the first pile capping was poured about a month later. The pouring of the roof slab was completed Aug. 10. Many of the floors were poured at the rate of one every five days. The brick followed shortly after the concrete and was completed Sept. 19. No difficulty was encountered during the construction, which proceeded somewhat ahead of the original schedule. The contractor's superintendent was of the opinion that time was saved by the use of the concrete frame in place of a structural steel frame. No time was lost waiting for steel bases or column sections, or for the steelwork to be erected before pouring the concrete floors.

In order to insure density of concrete, hydrated lime was added, averaging 5 to 7 per cent, by weight, of the cement. Slump tests were used in controlling the mix, allowing a slump of 5 to 6 in. for the floor concrete and 4 in. for beams and columns. For tests, 6-in. cubes were poured from both column and slab concrete at intervals. The former, when tested after 28 days, gave a strength ranging from a minimum of 2,800 lb. to a maximum of 3,870 lb. per sq.in., or an average of more than 3,000 lb.

Economy Through Use of Concrete—An important feature in connection with this building is the large saving in cost effected by the use of the reinforced-concrete frame instead of steel framing. This is clearly indicated by the accompanying comparative estimates. It will be noted that there is an indicated saving of approximately $50,000 by the use of reinforced concrete. This amounts to a saving on the cost of the structural frame of approximately 30 per cent. Looking at it from another angle, it means that the cost of the structural frame would have been increased approximately 42 per cent had structural steel been employed instead of reinforced-concrete.

Architect, Engineers and Builders—The architect for the Detroit Towers apartment was Walter W. Ahlschlager, Chicago. The structural design was worked out by the Gabriel Steel Co., Detroit. All construction work was performed by the Walbridge-Aldinger Co., Detroit, under the field supervision of T. W. Smith, as architect's superintendent and J. H. Gowan, as contractor's superintendent.

England to Have a "Super-Highway"

The proposal to build a new highway from Liverpool to Manchester, England, a distance of between 30 and 40 miles, has been approved. In discussing the project *The Engineer*, London, says:

"The Ministry of Transport has at last given its approval of the construction of a new road between Liverpool and Manchester, the cost of which is estimated at about £3,000,000, of which amount the government is to provide 75 per cent. The route to be followed, as at present arranged, will be fairly direct. There is a possibility that the road may be ultimately carried into Yorkshire without passing through Manchester. The route to Salford (near Manchester) avoids existing roads. Manchester is not contributing anything to the cost of the thoroughfare, as the City Fathers look upon the scheme as likely to be harmful to the Ship Canal—an attitude which is similar to that adopted by the railway companies when the Canal was projected."

Advantages of Double Chlorination of Water Supplies

DOUBLE chlorination of water is favorably regarded by C. R. Cox, division of sanitation, New York State Department of Health, in a paper included in the August *Journal* of the American Water Works Association. After reviewing the practice of some twenty plants, the advantages of double chlorination are summarized by Mr. Cox as follows:

1. Preparation of heavily polluted raw waters for filtration, so that the filter effluents will be of satisfactory sanitary quality before the final dose of chlorine is added.

2. The use of two independent chlorination plants at all times enables greater confidence to be placed in the disinfecting process, because it is unlikely that both plants will fail to operate at the same time, especially if the plants are housed in separate buildings. Both plants can be so connected that each will chlorinate either the raw water or filtered water, so that the failure of one plant will result in nothing more serious than the temporary chlorination of only the raw or filtered water until the other plant is repaired. The holding of a third chlorination plant in reserve will obviate the necessity of any interruptions in double chlorination.

3. Experience has shown that the exposure of bacteria to high concentrations of chlorine for relatively short intervals of time is more effective than exposure to lower concentrations for longer periods. The chlorine absorbing capacity of the average polluted raw water is sufficient to permit the addition of relatively large doses to the water entering coagulation basins without much, if any, free chlorine being present in the settled water applied to the filters. Such treatment subjects the organisms in the raw water to an active chlorine dose for much longer periods than obtain in the case of the usual dose applied to filter effluents, where long periods of contact cannot be used in many cases without having free chlorine in the tap water. The disinfecting action of the large prechlorine dose is more marked, therefore, even though most of the chlorine reacts very rapidly with the organic matter in the raw water.

4. The long reacting period in coagulation basins and the chlorine absorbing capacity of the filter beds at most plants permit relatively large overdoses of chlorine before free chlorine appears in the filter effluents. This is of practical value, in that it permits operators to overtreat raw waters at times of excessive pollution. In fact, the dechlorinating capacity of the filters makes the preliminary chlorination of the raw water comparable to superchlorination.

5. Prechlorination of water containing large quantities of organic matter may result in the formation of chloramine compounds which will persist in the filter beds and thus provide disinfecting action during temporary cessation in the application of chlorine.

6. Prechlorination aids coagulation. This action may be due to the effect of the chlorine dose upon the organic matter in the raw water, so that the physical state of the stabilizing "protective organic colloids" is altered, or that the organic matter is "aged" by the chlorine, through the formation of saturated compounds.

7. One of the advantages of prechlorination is the resulting oxidation of iron, the precipitation of sulphur compounds, and alteration of taste-producing essential oils due to algæ, through the formation of substitution products having no taste or odor. There may not be many plants where this factor is of major importance, but the existence of such a treatment agent under the control of operators would be a valuable adjunct to many filtration plants. In fact prechlorination of water applied to mechanical filters would enable final effluents to be produced which would be similar in quality to those of slow sand filters, where biological oxidation greatly changes the character of the dissolved organic matter.

8. Prechlorination prevents the growth of algæ and slime in coagulation basins and filters, although chlorine is not as effective as copper sulphate in the destruction of existing growths of vegetation.

The Pacific Coast Revisited

Some Observations and Impressions of Engineering Conditions and Accomplishments and of Political Machinations, as Seen from Vancouver to Los Angeles

By Frank C. Wight
Editor, *Engineering News-Record*

TIME is gradually breaking down sectional distinctiveness in the United States. Once you could almost guarantee the place a man came from by his clothes, his intonation and his behavior, just as you could have told where you were if set down blindfolded in an unidentified street of a familiar city. But easy transportation, standardized schooling, carbon paper journalism and nation-wide advertising are getting in their deadly work and state lines and mountain ranges are losing their ethnologic significance. Our automobiles are all made in Michigan, our clothes in New York or Rochester, our shoes in Lynn or St. Louis and our opinions and financial judgment and literary tastes in New York. The Calvin Coolidge we listen to over the radio is still obviously the Yankee and the silver dollar is legal tender only west of the Rockies—but most of the earmarks of sectionalism are vanishing with the buffalo and the horse.

Nevertheless the old fetiches still hold. The ninety-odd million Americans who do not live in the metropolitan district of New York continue to find there abhorrent tendencies their own favored home is spared and the Easterner visiting the Pacific slope notes many things that to him seem peculiar to a differing social structure. Especially does the Eastern engineer once over the continental divide sense certain developments and conditions which mark the West as different. To record the observation of these, as seen after an absence from the Coast of five years, is the purpose of this article.

Politics and the Engineer

The first observation is a generalization, and like all such is subject to specific contradiction; however, let us set it down. In the Far West political considerations govern engineering. It may be said that this is a condition not peculiar to the West, but certainly it is more obvious there than in the older settled parts of the country, and its effect is strong on all of the less tangible elements of the practice of engineering. It affects, for instance, the details of construction not at all and the details of design only slightly, but it puts its mark unmistakably on what may be termed the human side of engineering, the professional status, for one thing, which means in its turn the attitude of the engineer towards his work.

What is the manifestation of this condition? In practically every major city on the Pacific Coast there is a political squabble going on regarding the policy toward, or the operation of, some engineering project. Political lines are sharply drawn; factions or parties are definitely committed on opposing sides, each of which has its quota of engineering advisors, and each of which is using these advisors merely as pieces in the game, to be moved forward or backward as the exigencies of the political fight demand. In any one of them a group of outside engineers, disinterested and separated from the local wire-pulling, could come to an amicable agreement in a month, but all are so tied up to the major game of politics that engineering has become merely the journeyman assistant to the political manipulator. The journeyman details of the engineering are being carried out competently and capably but policies are dictated by anything but engineering considerations. Further than that, there are too many evidences of sinister political control of the engineering direction.

In this respect there is a distinct impression that the West has not progressed as far as the East in the separation of its engineering from political domination. One would be indeed naïve to assume that our big Eastern cities had a completely honest and upright government, but it is a fact that in most of them there has been established a continuity of engineering service which has brought to the direction of the engineering of these cities men who are not influenced by the temporary political situation and, further, that those who make a business of municipal politics have decided that engineering is a thing they had better leave their hands off. The responsible engineers in New York's municipal service, for instance, are all men of many years experience in the city, under changing administrations. They carry on, no matter who is in the mayor's chair, and the mayor knows enough of the practical business of city administration to let them.

The West, however, is a newer country. Engineering there is largely public engineering. Industry has not yet penetrated to any commanding degree. Most of the engineers have to earn their living working on those projects and services that come close to the people, and are therefore subject to the peoples' whim, through their elected representatives. And that leads to the answer to a question that disturbs any serious inquirer into the professional status of the engineer on the Coast.

Uninfluential Engineers

Because engineering is closer to the people on the Coast than in the rest of the country, engineers there seem to take a more intensive interest in public questions than they do in the more closely settled sections. Engineering organizations are more active in discussions of policies than they seem to be in the East. They are more vocal; they use publicity much more aggressively. They get together and discuss those problems which, by the nature of the development going on there, are both public matters and engineering matters —and they come to very definite conclusions thereon. But here comes the rub. Their opinions and conclusions seem to have very little influence. In many cases, as in the Los Angeles flood control controversy, the people seem to take delight in going absolutely contrary to the views set forth with such definiteness and force by those who ought to know what the people should have. What is the trouble?

Basically, the difficulty seems to lie in the lack of variety of engineering work on the Coast and the fact that every important engineer is a potential expert

to be employed by one side or the other in any of the public engineering questions on which the group of engineers passes judgment. This may or may not affect the judgment of the individual engineers who contribute to the group judgment, but the people have come to believe that possibly personal advantage may be being sought, especially as every so often the very men whose names go onto group opinions later appear as retained experts on the very question on which opinion was given. There are only a few engineers in Cleveland, let us say, who might be retained as transportation experts in a city owned subway campaign. The engineering group there then might very reasonably be expected by the citizens to give an unprejudiced generalized expert opinion on the subway problem if it should come up. There is hardly an engineer in Los Angeles who does not consider himself qualified, and rightly no doubt, as an expert on flood control. And there are only a few of them who have not at one time or another been retained on some phase of the question.

This is not a criticism of the engineers of the Coast. They are the victims of conditions. As work develops there and more kinds of engineering develop they will have a more diversified professional body and their group opinions may have more force than they now appear to have. Meanwhile, it is at least pertinent to note that the very decided opposition on the Coast to the employing of outside engineering experts brings with it as a consequence this inbreeding of engineering opinion which leads to suspicion of personal motive in every group action.

The Negligible Earthquake

At any rate the impression remains, and is set down for what it is worth, that the engineer on the Coast has a hard time keeping himself clear of the political boss and from the so-called business interests. Take the one very live subject of earthquake-proof buildings. They do have earthquakes in California. The structural engineers know it and nowhere in the country are there engineers who have studied more thoroughly the matter of earthquake-safe buildings. They have very definite ideas as to the kind of buildings that should be built in earthquake-subject cities. But do they have much success in getting the cities to require such buildings? They do not. It costs money to strengthen steel frames to resist earthquake-induced strains, and the more money a building costs the less return it brings, if it has to compete for occupancy with less sturdy structures. So the real estate interests go to the city and get amendments to the building laws or they prevent the adoption of better laws.

A leading Los Angeles banker told an Eastern engineer the other day that Bailey Willis ought to be run out of town. Bailey Willis, who knows a good deal about earthquakes, has been trying to put the fear of the Lord into that growing city. In San Francisco today there are two high steel frames going up almost on adjoining lots. One of them is one of the most thoroughly crossbraced frames to be found in this country; the other looks as though a fairly stiff breeze would blow it down. The first is designed far ahead of the San Francisco code by an engineer with a wholesome regard for what an earthquake may do and has an owner with a conscience. The second probably gets by San Francisco's inadequate code, and with luck will bring its owner the high return he is looking for. There is one bright spot ahead. The insurance people are getting worried and they are beginning to influence the bankers. Loans are going to be hard to get on unsafe buildings on the Coast and sooner or later those who make the building laws are going to be forced into action. The engineers will have their way about building design but they will get it only because they are beginning to get somewhere near the money nerve.

Roadbuilding Obligations

The automobile is bringing its share of problems on the Pacific slope. Whatever the statistics show there seem to be more motors there, all the way from Vancouver south, than in the rest of the country. Distances are great, rail connections are none too complete, the great outdoors has a universal appeal. So everyone motors. Auto camping, the great American sport, is there in its finest flower. One does not have to look for public camps; the forest roadside is ideal. One of the vivid impressions of five weeks in the West is the almost continuous line of auto lights and campfires seen from a sleeping car window the second night out from Portland on the Shasta Route. Buses go everywhere, even on overnight runs, and motor trucking is at least as heavy as anywhere outside the metropolitan East.

All this imposes obligations on the roadbuilding authorities that they must have difficulty in fulfilling. For the populations there are more scattered than in the East and the amounts that can be spent per acre served have to be less. Miles and miles of an excellent road east of Fresno with never a house nor a human being testified to the burden of cost that the road building programs lay. Nevertheless, throughout the West roads are going ahead fast. They are not usually of the highest type that are being built in the more congested East, nor do they need to be; there is a general lack of the excellent signing that the Middle Western highway departments, especially, are developing, but the man in an automobile today west of the Rockies can go almost where he wants to on safe and smooth highways. And most of the men there, and women and children, too, are going.

Way up in the Fraser River valley, northeast of Vancouver, this satisfying of the motoring demand is most evident. One goes down that valley on either of the two great Canadian railway systems—they preempt all usable low-grade right-of-way on opposite sides of the river—and far up the side of the three-thousand-foot-high hills one gets a glimpse now and then of what appears to be a road in the making. Once in a while there is a tunnel, every so often a bridge—a good solid modern example of what can be done with stout fir when one wants a bridge and steel is scarce and concrete expensive. Slipping around noses of the hills, jumping over runs, up and down on grades no railway could negotiate, this road winds down the whole valley, an impressive example of the engineer's answer to the automobile age. It is the western end of the great trans-Canada highway, that within a short time will tie Vancouver to Halifax. Each province is building its own link, and this is British Columbia's contribution. When it is completed, if a cross-valley view is any evidence, it will rank with Storm King and the Columbia Highway as a scenic route.

In the cities the traffic problem is being tackled with

somewhat more intelligence than in the rest of the country. Los Angeles, particularly, is to be commended for the great strides forward she has made in this respect. A few years ago downtown Los Angeles had the most dangerous and the most unpleasant streets in the country. With a population apparently more blessed with leisure than in any other large city and with an enormous number of cars, this marvel among cities came to be almost impassable downtown. Something radical had to be done. The longtime possibility of new streets and around town boulevards was not neglected, but immediate attention was paid to pedestrian and motorist education and an efficient signal system. The authorities there have learned what so few of our Eastern cities have, that short-time intervals in stop-and-go signals are the salvation of any traffic system and that pedestrian control at crossings is fully as important as motor control.

In consequence of the new signal system traffic moves through downtown Los Angeles with surprising speed and pleasing comfort. A motor clearing interval of around 40 seconds is preceded by a 10-second pedestrian interval during which all motor traffic stops, and any pedestrian who moves out into the street in his closed period is arrested. Cars move along with rare stops and if they do stop they do not have to stop long and pedestrians stand at curbs in perfect acquiescence to the signals, knowing their wait will be short. Contrast this with the overpraised New York system of three or four minute north and south intervals with scurrying pedestrians dodging traffic in defiance of life and order. Whatever animadversion may be made on other engineering peculiarities of Los Angeles, the traffic control there is to be admired and copied.

Seattle, too, is experimenting with a similar system, but not quite so successfully it seems, because probably the area of control is extended too far outside the crowded district, with consequent frequent subservience to signals not demanded by the traffic. San Francisco remains San Francisco, peculiar to itself. There is surprisingly little traffic control, even on outrageous Market St., with its four lines of street cars, and six to eight lines of motors, but one gets around, just how and why it is difficult to say. San Franciscans come from a hardy stock; they have inherited an ability to take care of themselves. As for Vancouver, the higher prices of motors—and perhaps the lesser degree of Canadian prosperity—shows itself there, for with hardly any attempt at control the motors on the streets never seem to be sufficient to cause worry to policeman or pedestrian.

These are only some of the things that have appealed to an engineer visiting the Coast for the first time in five years. Many others might be expanded upon were there space. The Coast is growing rapidly and engineering expansion is a part of that growth. One might describe the remarkable technique that is being displayed in the finishing of concrete in Los Angeles, or recite the transformation of downtown San Francisco into a city of skyscrapers. There is a story in the inroads that the Rotarian spirit is making into engineering and contracting circles, a spirit manifest in the multiplicity of organization and the inevitable luncheon or dinner and the urge toward reform. There is the obligation to communicate to someone else the inspiration gained from a three-day trip into the High Sierras, where engineers who would gladden a movie man's heart are turning running water into light and power—and refrigerators and washing machines.

But these must wait. We return to the theme of the first paragraph. In spite of our growing standardization, there is something different once you slide down the west slope of the Rockies and that difference communicates itself to engineering. The engineers are just the same as farther east, but their problems and their medium are different. They know more about dams and less about sewage disposal than the Easterners. They are more intense individualists. They function better as the big boss of a small outfit than as the necessary cog in a big machine; they would rather be first in a little Iberian village than second in Rome. But they are an important, perhaps the most important, factor in the upbuilding of a West which has long since outgrown its pioneer days, but which is still growing and building. And they suffer the fate of most builders—they are none too well appreciated by their community and their contemporaries.

Maximum Shear Formulas for Lane-Loading of Highway Bridges

Live-Load Assumption for Highway Bridges Adopted Recently by State Highway Officials Basis for New Shear Formulas

By C. M. Strahan
Professor of Civil Engineering, University of Georgia

A TYPE of lane loading for highway bridge live-loads consisting of an assumed uniformly distributed load per running foot of a roadway lane 9 ft. wide together with a single concentrated load has recently been adopted by the Association of State Highway Officials through its bridge design committee. The load intensities are adjusted to the several classes of bridges and traffic densities. Both live-loads are to be so placed on the bridge as to give maximum shears and moments in the respective panels and thus produce maximum stresses in the several web and chord members. Hence it may be of interest to some to recall certain convenient formulas for maximum shears in simple trusses and state them in a form adapted to this type of live-load. Their application saves a good deal of work and their derivation in detail by students is a most helpful and instructive exercise in stress analysis for simple trusses.

As a nomenclature for the formulas assume:

n = the total number of panels in the truss on the loaded chord
l = panel length
m = the specific number of the panel considered, counted from the end where the live-load enters (usually the left end)
W = the dead-load per panel
W_1 = the uniformly distributed live-load per panel
P = the single concentrated live-load used.

Entering from the left and considering the dead-loads per panel only, positive shears exist in all panels up to the center of the truss and negative shears in all panels beyond the center. The general formula for dead-load shear in the truss (imposed at panel points by the floor system) may be written: $\frac{1}{2}(n-2m+1)W$.

This gives positive values until $m > \frac{n}{2}$.

The live-loads entering from the left produce negative shears only in front of the load for each successive panel. For the uniformly distributed live-load, we may assume either a full panel load at each loaded point, or the more exact mathematical assumption that the live-load extends out on the mth panel a distance $x = \frac{m-1}{n-1} l$. For the full panel assumption, the maximum shear in the mth panel is given by $-\frac{m^2-m}{2n} W$.

For the more exact assumption, the maximum shear is given by $-\frac{(m-1)^2}{2(n-1)} W$.

The single concentrated load P, gives a maximum shear in the mth panel of $-\frac{m-1}{n} P$. To represent

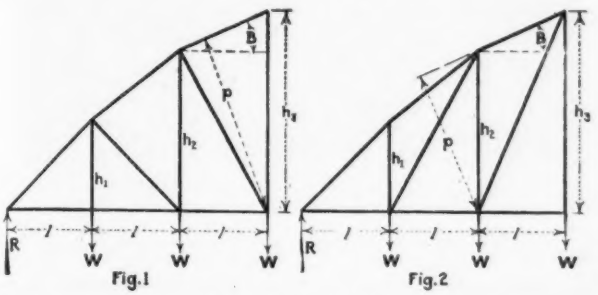

Fig.1

Fig.2

the combined maximum shear in the mth panel from all loads we write for the two cases above:

Formula (A) Full panel assumption:

$$S_{max} = \frac{n-2m+1}{2} W - \frac{m^2-m}{2n} W - \frac{(m-1)}{n} P$$

Formula (B) Exact assumption:

$$S_{max} = \frac{n-2m+1}{2} W - \frac{(m-1)^2}{2(n-1)} W - \frac{(m-1)}{n} P.$$

Formula A gives slightly larger values than formula B and thus is on the safe side. Formulas A and B are equally serviceable in computing the maximum countershears when the live-loads are on the shorter segment of the truss, i.e., when m has values less than $n/2$. It is now easy to pass from the maximum panel shears as derived from the formulas to the corresponding stresses in the diagonals and verticals of each panel considered.

For trusses with parallel chords, the maximum stress in a diagonal is given by multiplying the maximum panel shear by the secant of the slope of the diagonal to the vertical plane. Note also that when the diagonal of a panel has its maximum stress, the forward vertical in that panel has its maximum stress as well, equal in amount to the panel shear.

For trusses with inclined chords, the formulas give the maximum shears in the panel regardless of the inclination of the chord members. But the total shear is divided between the chord member and the diagonal. In this connection the writer has not seen elsewhere the following rather simple method of computing that portion of the total shear which produces stress in the diagonal. This is the important maximum stress for such panels, since the maximum chord stresses will be produced by a different position of the live-loads, namely when the whole truss is as heavily loaded as possible. For an example take the case of the curved-chord Pratt truss in Fig. 1 and consider the third panel.

Let S_3 = the maximum shear in the third panel from all loads $= R - 2W$.

S_2 = Corresponding shear in 2nd panel $= S_3 + W = R - W$.

S_1 = Corresponding shear in 1st panel $= S_2 + 2W = R$.

Let V = vertical component of stress in main diagonal of this panel.

U = vertical component of stress in inclined chord.

T = total stress in the inclined chord when maximum shear in the panel is produced.

By the method of sections (see Fig. 1):

$$T = \frac{R \cdot 3l - W \cdot 2l - W \cdot l}{5p}; \quad p = h_3 \cos B; \text{ and } V = S_3 - U.$$

$$U = T \sin B = \frac{3Rl - 3Wl}{h_3} \cdot \frac{\sin B}{\cos B}; \text{ and}$$

$$\frac{\sin B}{\cos B} = \tan B = \frac{h_3 - h_2}{l}$$

$$U = \frac{3Rl - 3Wl}{h_3} \cdot \frac{h_3 - h_2}{l} = \left(3R - 3W\right) \frac{h_3 - h_2}{h_3}$$

But $3R - 3W = R + (R - W) + (R - 2W) = S_1 + S_2 + S_3$

and

$$U = (S_1 + S_2 + S_3) \frac{h_3 - h_2}{h_3}$$

Formula (C): $V = S_3 - (S_1 + S_2 + S_3) \frac{h_3 - h_2}{h_3}$

= maximum vertical component of stress in main diagonal.

If the truss in Fig. 1 were inverted the value of V would remain the same in amount, but the stress in the diagonal would be reversed in character. If, however, the direction of the diagonals be changed so that the truss takes the form shown in Fig. 2, formula C no longer applies but is easily modified into formula D:

$$\text{Formula (D): } V = S_3 - (S_1 + S_2) \frac{h_2 - h_1}{h_2}$$

Formulas C and D may be written in a general form as follows, where m is counted from the nearest support and S is the total shear in each successive panel.

$$\text{(C)—Max. Shear in diagonal} = S_m - \Sigma^1_m S \frac{h_m - h_{m-1}}{h_m}$$

$$\text{(D)—Max. Shear in diagonal} = S_m - \Sigma^1_m S \frac{h_m - h_{m-1}}{h_{m-1}}$$

Note that the summation of the shears under formula C includes the shear in the mth panel itself, while under formula D the shear in the mth panel is omitted.

The foregoing discussion and formulas are readily applied to the Warren, Howe, Pratt, and bowstring trusses and to the main panels of trusses like the Baltimore and Pettit trusses which have secondary web systems. For ready use by bridge designers, the formulas can be used to compute tables of coefficients for the various kinds of trusses to which they apply covering a range of as many panels for each type as may be desired.

Jerusalem Is Developing New Water Supply

A new provisional water supply system for the city of Jerusalem, carrying 200,000 gal. daily from Ain Farah Springs, 7 miles away, with a rise of 2,000 ft. during transit, was put in operation in July, 1926, according to a report to the United States Department of Commerce from O. S. Heizer, consul at Jerusalem. Extensive plans for developing water supply and hydroelectric power from the River Jordan are under way.

Old Timber Truss Bridge Used for Erecting Steel Arch

Method Adopted in Railroad Bridge Replacement on Clackamas River in Preference to Cantilever Erection

By Henry F. Blood
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IN THE erection of a steel arch bridge over the Clackamas River at Faraday, Ore., 36 miles southeast of Portland, on a branch railroad of the Portland Electric Power Co., the unusual expedient was employed of making use of the old wooden bridge which the new arch replaced, as falsework for the erection of the arch.

FIG. 1—OLD TIMBER SPAN USED AS CENTERING, FARADAY ARCH

The old structure was a 170-ft. deck Howe truss of timber, while the new one is a three-hinged spandrel braced arch of 191 ft. 8 in. span, carrying a single track. The work was done in 1922, but because of the unusual method employed a description may still be of value.

At the bridge site, the river flows through a deep canyon; track level is 120 ft. above the usual summer water level. The river is 80 to 100 ft. deep here, and the volcanic conglomerate walls of the canyon rise sharply from the water and are rough and precipitous. While falsework could have been constructed, it was not desirable to do so owing to the depth of the water and of the canyon. It would have been necessary to build out from each side of the river without supports in the water, and this would have been expensive. The arch type of bridge was therefore adopted.

It was planned at first to erect the two halves as cantilevers, using backstays of eyebars anchored in large concrete blocks some distance from the top of the canyon, and adjusted by toggle joints. A design for this method was prepared, and holes for 3-in. pins were provided at the end panel points of the top chords. But on further consideration it was decided to try the use of the existing wooden span for falsework. A check of its strength showed the members to have sufficient capacity for the erection loads, and careful surface inspection indicated that the timbers were fairly sound. The contractors favored using this method.

The corrugated-iron covering of the old bridge and all other material which was not essential was removed, the end verticals and the top chords beyond the hip joints were cut off, loose joints were tightened, and the trusses were put into as good shape as possible. The steelwork for the south half of the arch, as well as all tools and equipment, was taken across the old span.

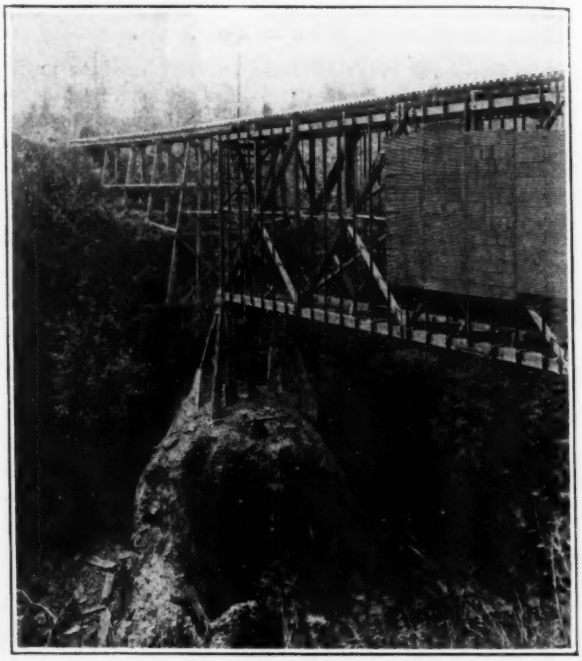


FIG. 2—STRIPPING OLD HOWE-TRUSS SPAN FOR USE AS FALSEWORK
Below the end bent are caves in the rock wall of the gorge. In the background is excavation for one of the arch footings.

To facilitate sorting of the steel at the site, the material for the two halves had been painted different colors by the shop. This proved a great convenience. The principal erection tools were two derrick cars, one working on each end of the span.

After all materials and equipment required had been moved to the south side, the track and stringers of the old span were removed, reducing its weight to about 120 tons. The arch steel weighed about 200 tons.

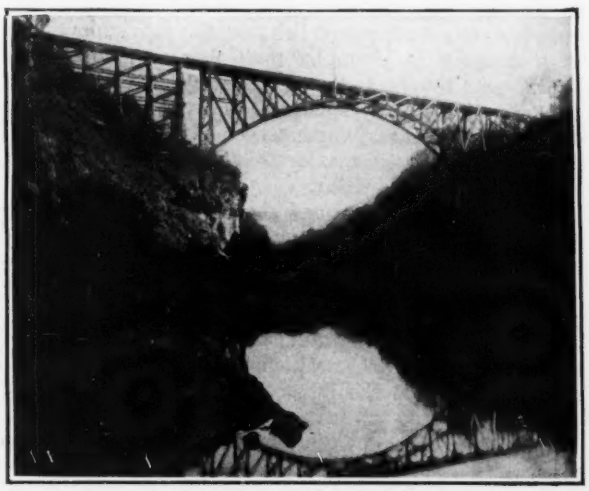


FIG. 3—FARADAY ARCH, CLACKAMAS RIVER

The old span was now lowered 22 ft. and moved endwise about 9 ft., to the south, after which it was set on heavy timber grillage. Shores and blocks were placed as required to support the new span. The lowering was done by the aid of four 40-ton jacks at each end placed in pairs near the end panel points of the bottom chords; the operation required 5½ days. To move the span horizontally one 50-ton jack was set horizontally against the north end of each of the two bottom chords, and the span was moved on small steel rollers placed on longitudinal timbers.

There was no racking or jarring of the span during the process of lowering, and it appeared when lowered to be in as good condition as at the beginning. No weakness developed at any time while the erection of the arch was in progress. However, the workmen were nervous about working over it, and there was much difficulty in holding men for any length of time. They were quitting frequently and new men had to be employed. The contractors showed their confidence by staying on the arch along with the men.

The arch was erected by working out from the ends, using the derrick cars to handle the members. Both halves were erected slightly raised at the center, but one end was kept 6 or 8 in. higher than the other, so that when it was lowered the pin plates would slide down past the plates of the adjoining end. Jacks were placed under the lower chords from the first panel each side of the center. When the bridge was ready to have the center pins installed, the jacks were lowered until the pin holes of both halves of the arch were in line, and the pins were driven without difficulty. Erection took only 19 days.

The old span was removed by suspending wire ropes from the lower-chord panel points of the arch to the bottom-chord panel points of the old trusses, and dismantling it piece by piece. All materials, except the bottom laterals, were hoisted up to the new span and piled as directed on the level ground near the north end of the bridge. The bottom laterals, being held in place only by the pressure of the tie rods, loosened and fell into the water when the bridge was partly dismantled. Both the erection of the arch and removal of the old span were accomplished without any accident of importance to workmen or equipment.

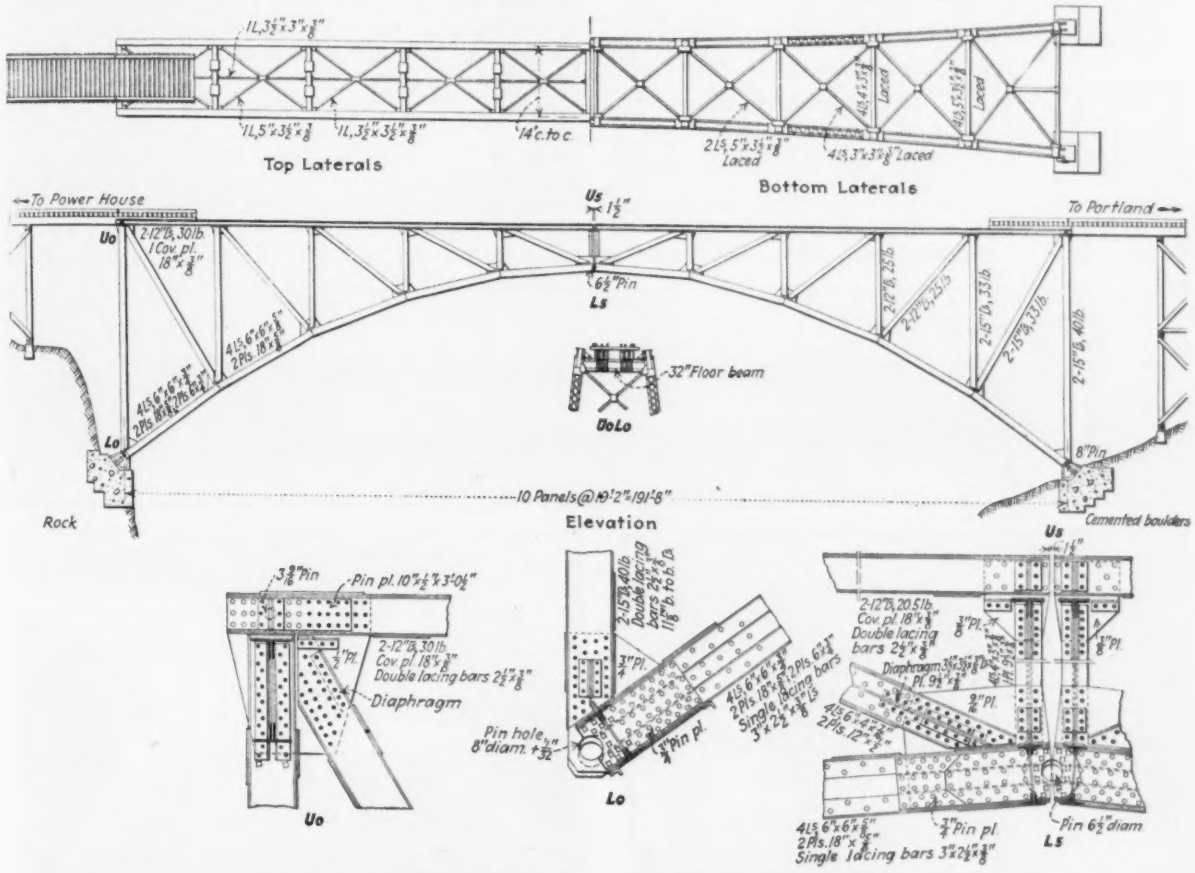


FIG. 4—STRUCTURAL FEATURES OF FARADAY ARCH

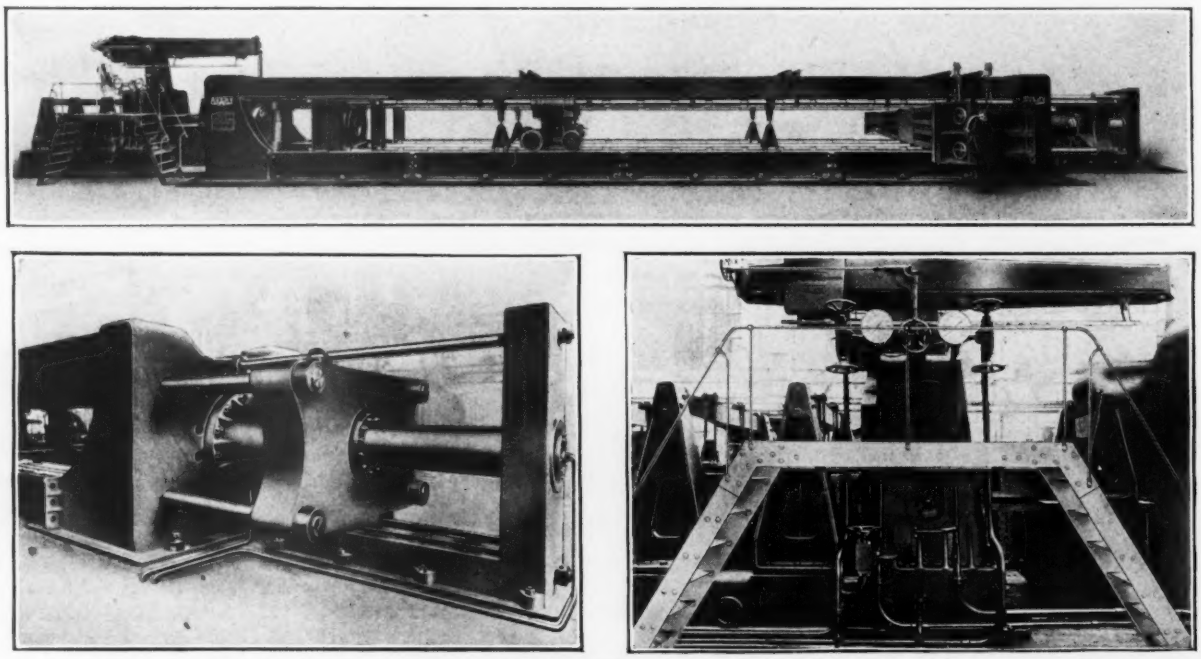
Considerable difficulty was experienced in connection with the foundations. During the excavating it was found that the rock was poorer in places, especially at the north end, than the previous examination had indicated. In some instances the material showed a tendency to disintegrate soon after exposure to the air. Fragments of soft blue stone and small pieces of petrified wood would be found at a considerable depth below the surface. It was necessary to enlarge the piers at the north end very materially and one of the south piers slightly. Careful study and judgment were required to insure foundations which would be safe and yet not add unnecessary cost. Most of the rock had to be loosened by light blasting. Only small shots could be used, as the excavations were so near the supports

of the old span that there was danger of injury to these.

The bridge was designed for the Portland Electric Power Co. by Blood & Williams, consulting engineers, of Portland. Thomas Pumfrey, chief engineer of maintenance for the company, had the direction and supervision of the work. Booth & Pomeroy, of Portland, who had the general contract for foundations and erection, handled the work in very satisfactory and efficient manner.

Large Universal Testing Machine Built in England

FOR the purpose of testing structural members and details of the Sydney Harbor arch bridge, Dorman, Long & Co., Ltd., of Middlesborough, England, the contractors for the bridge, are installing a universal testing machine of remarkable size, built for them by W. & T. Avery, Ltd., of Birmingham. The machine is of horizontal arrangement and has a load capacity of 2,800,000 lb. Its length and internal clearances are sufficient for testing built-up members 50 ft. long and 45 in. square in either tension or compression. For transverse tests, a special crosshead girder will receive members 42 in. thick, of any depth, and 20 ft. in span.



HUGE TESTING MACHINE BUILT FOR TESTS OF STRUCTURAL PARTS OF THE SYDNEY HARBOR BRIDGE
Built by W. & T. Avery, Ltd., of Birmingham, England, for Dorman, Long & Co., Ltd., of Middlesborough, contractors for the bridge. Lower views: Left—Hydraulic arrangement for applying loads; right—hydraulic and poise weight controls.

Many of the more important parts of the Sydney Harbor bridge can be tested full size in this machine. Some of the largest members, however, will have to be tested in model size.

The Avery machine uses hydraulic pressure for applying the load, but measures the load by a lever weighing system at the opposite head. The hydraulic plunger is 32 in. in diameter, has a stroke of 5½ ft., and is plated with copper to protect it from corrosion. The plunger is returned by a 20-in. stationary inner plunger. The weighing mechanism has four primary levers, each with knife edges 62 in. long, giving a total knife-edge length of nearly 21 ft. (proportioned on a basis of 5 tons per inch of length). These levers, giving a reduction of 6:1, are followed by a 5:1 bell-crank lever which transmits the pull of the load to the weighing steelyard. The latter covers the full capacity range of the machine by a single traversing poise, without loose counterpoise weights.

Lower and upper members of the main frame are respectively trough-shaped castings and steel box girders. Between them are a compression head at the hydraulic end of the machine and a tension head at the weighing end, connected by four round steel bars and suspended from the upper girders of the frame by a system of knife-edges. The weighing levers are connected to this suspended system. Between these two heads is located the straining crosshead, which is a steel casting capable of traveling on the bed on four wheels and adapted to be fixed at any point on four long straining rods which transmit the push of the hydraulic plunger; the movable head is connected to these rods at the desired points by split collars engaging grooves in the rods. In this head a spherical tension-grip holder is seated in the face directed toward the weighing end of the machine, while its other face forms a platen for compression testing and may be fitted with adjustable seats for pin-end tests.

The overall length of the machine is 120 ft. All manipulations during a test are made from the operator's stand at the weighing end, where the valves controlling the hydraulic ram are also situated. Operating power is furnished by a battery of high- and low-pressure accumulators served by two sets of double-acting motor-driven pumps.

In comparison with the Avery machine, the large Olsen machine at the United States Bureau of Standards in Washington has a load capacity more than three times as great (10,000,000 lb.) and can take specimens up to 24 ft. long, but is fitted for compression testing only

(except that bending tests up to about 1,000,000 lb. can be made on girders 22 ft. long). The large Emery machine at the Bureau can take specimens of about the same length, and has a capacity of 2,300,000 lb. in compression and 1,150,000 lb. in tension. A number of universal machines of 600,000 to 1,000,000 lb. capacity are in testing laboratories of technical colleges. All these have weighing mechanism separate from the straining device. A tension testing machine for eyebars, of 4,000,000 lb. capacity and long enough for 35-ft. bars, is at the Ambridge plant of the American Bridge Co.; in this the load is measured by pressure-gage reading on the hydraulic straining jack. A general testing machine of 6,600,000 lb. compression and 3,300,000 lb. tension capacity at the Gross-Lichterfelde laboratory in Germany has clearance dimensions comparable to those of the Avery machine and surpasses it in load capacity. Both of these machines, thus, are considerably larger than any American testing machine.

San Francisco Makes Fills with Residue from Destructor

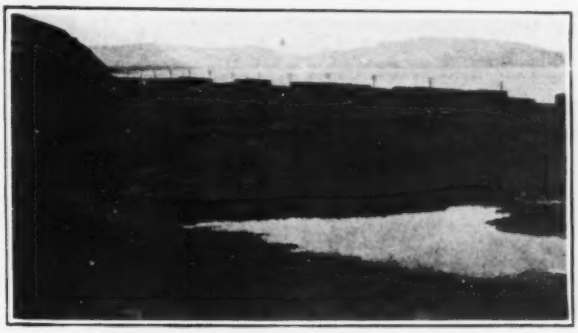
Total of 600 Tons of Refuse Handled Daily—Ashes and Unburned Waste Delivered in Railroad Cars to Fills on Bay Shore

ASHES, partly burned garbage, and other refuse from the old Thackeray destructor in San Francisco are disposed of by filling lowlands along the railroad track on the Bay shore south of the city. This work is being done by the Scavenger's Protective Union (not incorporated) which disposes of the refuse under permit from the Board of Public Works. Due to the greatly overloaded condition of the old destructor and its consequent inefficiency, constituting a neighborhood nuisance, there is vigorous agitation at present for some better disposal system and the Board of Supervisors is given the matter attention.

In San Francisco there is no segregation of garbage except by hotels and restaurants and all refuse is collected by private scavengers whose only responsibility to the city is in the form of a permit which gives the Board of Health control over sanitary conditions. Householders pay the scavenger direct, in accordance with an elaborate schedule formulated or approved by the city authorities. Scavengers operating in various parts of the city have grouped together to form associations. These associations elect their own officers and their principal duty is to arrange any necessary exchange of customers in the interests of distributing the collections so that the routes can be arranged with maximum efficiency. A total of about 600 tons of refuse is collected daily by the scavengers, and in addition to this hog raisers buy and collect from hotels and restaurants about 125 to 130 tons of garbage each day.

The 600 tons collected by scavengers is all delivered to the Thackeray destructor, now about 30 years old, located in the eastern portion of the city near the Bay shore (see *Engineering News*, 1900, I., pp. 318, 325). The capacity of this destructor is about 400 tons per 24 hr. and hence the daily deliveries of garbage cause extreme congestion at the plant. About 100 tons of the refuse is daily burned in the open at the destructor yard and the other 500 tons is crowded through the destructor. Thus, about 25 per cent of the tonnage going through the destructor comes out partly unburned.

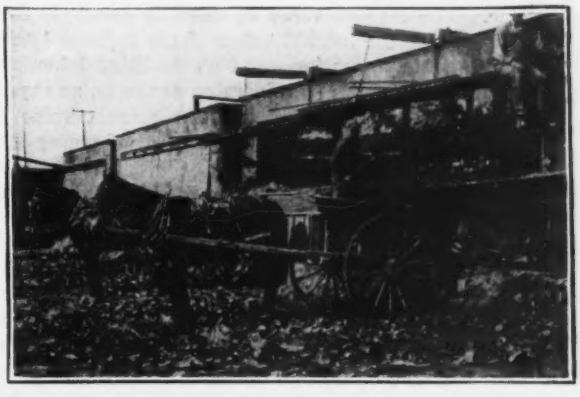
Each scavenger pays $1 per ton for all refuse delivered to the destructor. This payment goes to the Scavengers' Protective Union which operates the plant and is charged with the responsibility of effecting sanitary disposal within this price. Of late the costs have somewhat exceeded this rate, so that the Union has been running behind and the scavengers may have to charge a little more per ton for disposal.



GENERAL VIEW OF REFUSE FILL ALONG RAILROAD TRACKS
Note railroad sidings laid on fill for cars of refuse.

The ashes, unburned garbage, etc., hauled away from the destructor, amount to from 250 to 270 tons per day, including 15 to 20 tons of ashes and residue from the material burned in the yard. This hauling is done by the Southern Pacific R.R. which has about 30 side-dump cars used exclusively for this service. The railroad takes a 9-car train daily (capacity of 28 to 30 tons per car) from the destructor to the fills, some 5 or 6 miles distant, for which a switching charge of $2 per car is made.

At the fills the contents of the cars is loaded into dump carts in which is it delivered to the point where the face of the fill is being extended. The preferred method of loading is for the worker to stand in the cart and rake the refuse down from the car. When the side doors are first opened there is a good deal of spillage, of course, and this has to be shoveled up into the carts from the ground.



METHOD OF UNLOADING AND DISTRIBUTING MATERIAL FROM CARS
Note that fill packs well. Refuse spilled is shoveled into carts.

Ordinarily, it takes a crew of 10 or 12 men on the dump working 8 to 10 hr. per day to take care of the daily delivery from the destructor. The number of one-horse carts ranges from 7 to 10. Cost for railroad

switching charge and horses and carts averages around $750 per month. Only the residue from the destructor is used in making these fills. No complaint has been made regarding any nuisance in connection with them.

The present fill is about 15 acres in area and averages about 6 ft. in depth. Prior to starting on this area a similar depression about one mile north was filled to an average depth of 9 ft. over 20 or 25 acres. The extent of that fill was sufficient to take care of the residue from the destructor for a period of 4 to 5 years.

Some Fallacies in the Valuation of Water Power

A Few of the Contentions Frequently Made in Court to Increase the Award of Damage for Diverted Water

By Alton D. Adams
Engineer, Wellesley Hills, Massachusetts

SEVERAL subtle perversions of fact have added millions to the damages awarded for water diverted to municipal supply. These fallacies will grow more important from this time forward because the number and volume of water diversions from power plants will largely increase, with the rapid development of water power now under way. Future diversions for constantly increasing municipal populations and irrigation areas must frequently damage this expanding development of water power.

Market Value Fallacy—In spite of the legal rule that the damage to an estate from which water is diverted is its decrease in market value, expert witnesses frequently attempt to measure such damage by the market value of all the power that the diverted water might develop. The market value of possible power is thus substituted for the market value of the injured estate.

To substitute power for water as the thing taken and to be paid for, in suits for diversion damages, an expert witness is brought to testify to the market value of power in the vicinity, and to the amount of power that the diverted water might develop. Clever counsel then argues that the plaintiff should be paid the full market value of all the power that the water might develop.

Of course the fact is that the plant from which the water has been diverted is only damaged by the increased cost of power production. The damage may accordingly be measured by the necessary increase of operating expenses to replace by fuel the water power lost, a sum that is far less than the market value of the power. It is just as unreasonable to argue that the damage for diverting water is measured by the value of the water power it might develop as to argue that the damage for taking a pile of coal is measured by the value of the steam power it might produce. To generate power in either instance there must be construction, equipment, operating supplies and labor, all of substantial cost, besides the water or the coal.

Some forty years ago a New York court pointed out the fundamental fallacy that underlies the claim that the market value of power measures the damage for diverted water. A small stream ran past a brickyard to the Hudson River, and some of its water was used to make brick. This stream was diverted to supply Fishkill, and Van Buren, the lessee of the yard, had to suspend work twenty-five days, and produce 1,000,000 less brick than would otherwise have been made. Van Buren sued for the value of 1,000,000 brick as damages for the diverted water, but Judge Barnard refused to sustain an award on this basis and pointed out that the rule gave the value of the brick without deducting the value of the clay, and that it would not be just to give the plaintiff the value of 1,000,000 brick while the clay remained in the bank, and labor was never expended to make the brick (*Van Buren vs. Fishkill Water Works Co.*, 50 Hun. 448).

In the celebrated Kettle Brook case of 1895, the fallacy that the market value of power that might be developed measures the damage for diverted water was strongly urged by expert witnesses and counsel for the mill owners, and opposed by the late Senator George Frisbie Hoar for the city of Worcester. Senator Hoar contended that the city had taken no power whatever, but only water which must be combined with equipment and other elements, at large expense, to produce power. In the Kettle Brook case the award for diverted water that might have developed 1,000 hp. on its journey down the Blackstone River to Narragansett Bay was $500,000.

Increased Expense Fallacy—When the cost of fuel power to make good the loss of diverted water is estimated, another fallacy is often committed by the assumption that water power is produced with water only, thus neglecting the cost, depreciation and operating expenses of hydraulic plant.

Interest and depreciation on the cost of hydraulic construction and equipment, plus operating supplies and labor, represent most of the cost of water power, and in some instances approximate that of steam development. When water is diverted and must be replaced by fuel power, the damage is not the entire cost of the new supply of energy, but only the increase over the expenditure when water was used. A fallacy is thus committed when the full cost of fuel power is presented as the damages of diversion, with no deduction of the amount saved by the discontinued water operation.

Lost Water Fallacy—So again, it is a mistake in many instances to base an estimate of damages on the entire volume of water diverted from a river, because the greater part of this water returns by sewers to the same stream, often before the power plant in question is reached. In so far as the water is only polluted and not dissipated by use, its capacity for power production is not lost and no power damage is suffered. Worcester drains into the Blackstone and is high and well sewered, so that a large percentage of the water diverted from Kettle Brook must reach the river, but no account of this fact appears to have been taken in the award of $500,000 for diverted water. The same is true in a number of other cases.

Where the water is carried out of its natural drainage area to another watershed, there is a total loss of the power capacity of the diverted water along the stream from which it comes. Such a condition appears in the water-supply of New York and Boston, where the used water never returns to its natural course, but is sewered direct to the ocean.

Constant Loss Fallacy—A frequent fallacy lies in the assumption that the water diverted represents a constant loss of power throughout each year. This assumption is far from the truth because a power development in a river usually has a water capacity equal to only

a minor fraction of its maximum rate of discharge. Reason for such development is found in the fact that river discharge is not a constant quantity but varies from day to day, month to month and year to year, and may be fifty or more times as great on one day as on another.

Take the discharge of the Connecticut River at Holyoke, for example. During a period of twenty years ending with 1899, the rate of discharge varied from 1,600 sec.-ft. during a day of 1894 to 115,000 sec.-ft. during a day of 1895. This maximum was thus nearly 72 times as great as the minimum daily discharge. In 1894 the maximum daily discharge was 43,300 sec.-ft., or 27 times the minimum of 1,600 sec.-ft., and in 1895 the maximum daily discharge of 115,000 sec.-ft. was 42 times the minimum of 2,700 sec.-ft. for that year. Every one of the twenty years had one or more days when the discharge was not more than 3,650 sec.-ft. On 3,855 days during the twenty years, or 52 per cent of the total period, the discharge of the Connecticut River was less than 8,000 sec.-ft. This 8,000 sec.-ft. which was available in the river less than one-half of the time, is just under seven per cent of the maximum discharge. The foregoing figures for the Connecticut River are derived from Vol. 58, *Transactions*, American Society Civil Engineers, p. 32.

Because of such facts as to discharge, waterpower plants generally have no more than enough capacity for the flow that is available at least one-half of the time. It results that diversions for municipal supply usually reduce the amount of power available at existing plants during no more than one-half the time. During the other half of the time more water flows in the river than the power plant can use, even after the diversion has taken place. How unreasonable then to base damages on the supply of fuel power during the entire year, when the river discharge is greater than the plant can use during about one-half the year.

Former Justice Pitney of the United States Supreme Court, when Vice Chancelor of New Jersey at an earlier date, applied the principle that the estimated cost of fuel power to replace diverted water should be applied only during the time when the diversion results in a deficiency at the plant (*Sparks Mfg. Co. vs. Town of Newton*, 57 New Jersey Equity 367).

Combination of Fallacies—Some damage claims for water diverted from Esopus Creek by the great Ashokan dam for the supply of New York City included several of the above fallacies, and the awards were rejected by the court.

Ashokan dam impounds all the water of Esopus Creek at that point, and this water is carried to New York City so that none of it ever returns to the bed of the creek. There was an undeveloped waterpower 28 miles below the dam, and a developed power about 30 miles below the dam. The testimony was that about three-fifths of the natural flow of Esopus Creek at these sites was lost by the diversion of the dam. Commissioners awarded $145,000 for damage to the undeveloped and $395,000 for damages to the developed power. Judge Howard set aside all of these awards as against "sober common sense," and part of his opinion as to the award of $145,000 for the undeveloped waterpower is here given, as too picturesque not to be quoted:

"This claimant has a 'ledge of rock' across the Esopus Creek constituting a natural dam; that is all he has. He has no right to raise or lower the slack waters held back by this ledge of rocks. He has no mills, no raceways, no industries, no pondage rights—nothing but the naked waters tumbling over the rocks. Before the Civil War a few logs were bolted to the rocks creating a sort of crude dam, and some unpretentious industries were supplied with power and struggled along for a time at Glenerie, and died. But for more than a quarter of a century the place has been as stagnant as a graveyard and has been known, the country round, as the 'Deserted Village.' The dam is gone, the buildings are tumbled down, the waters are run to waste. And this is the property which the commissioners say has been damaged to the extent of $145,000. Nobody but a novelist or an expert would have sufficient imagination to convert these rookeries and ruins into a substantial fortune."—(*Sands vs. New York*, 104 Misc. 427. Sept., 1918.)

Good Chimney-Building Practice

"A chimney built of brick or stone has many mortar joints which may not be absolutely tight. Therefore, any method by which the number of joints can be reduced or protected is of the greatest value. Formerly this was done by parging, or plastering the inside of the flue, but as the plaster eventually falls off and is not impervious to flue gases, this method is not only not approved but is prohibited in many places. The solution lies in the use of flue lining. Standard linings of fire clay being at the minimum 2 ft. in length, the number of exposed mortar joints for brickwork is reduced from 10 to 1. Being made of fire clay, they are unaffected by the flue temperatures and flue gases. The thickness of the walls of the chimney when such flue lining is used may vary according to type and location, with 4 in. of brickwork as a minimum, though 8 in. is preferable to conserve heat losses. As a matter of common sense, all woodwork and other combustible materials should be well insulated from the chimney. In building a chimney each section of lining should be carefully placed on the section below with a thoroughly mortared joint surrounded by not more than two courses of brickwork, flushed in, to steady the lining; the brickwork should then be built up around the lining, flushing in mortar between the brick and the lining as each course is laid with full bed and vertical joints. Unfortunately, this method is not as quick or easy as building up the brickwork and dropping the lining down. Consequently the latter method is most frequently used, the joints are not tight, and the linings are not properly set with a tight filling of mortar all round. If each flue is given a thorough smoke test any leaks will be discovered and can be made good at once. It is important that the test should be made by the mason contractor and not by the heating contractor. Specifications frequently call for the latter to test flues before connecting heating apparatus and to report any leaky flues for correction, but by this time the mason may have left the building and perhaps have been paid, and, as is often the case, the building itself may have been plastered or so far finished that corrections are both difficult and costly, and so the conditions are tolerated in spite of the perpetual fire menace as well as the annoyance and added cost of heating."—D. Knickerbacker Boyd in *Quarterly* of the National Fire Protection Association, April, 1926.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Source-Book on the Seven-State Colorado River Compact

THE COLORADO RIVER COMPACT—By Reuel Leslie Olson, A.M., J.D., Ph.D., Professor of Law, University of Southern California School of Law, Los Angeles, Calif., Member of California Bar, Officier d'Academie. [Thesis submitted in partial fulfillment of the requirements for the Degree of Doctor of Philosophy, Division of History, Government and Economics, Harvard University, 1926.] Published by the author. Cloth; 6x10 in.; pp. 527; 3 photographic plates, 5 line plates; appendices of documents, personnel lists, and bibliography. $8, from the author, as above.

Professor Olson makes available here what is in effect a source book of facts and documents relating to the Colorado River Compact, that curious shipwrecked agreement between the seven states of the Colorado River Basin which was designed to settle the interests of those states in the great river of the West for all time—"in perpetuity," to use the fatal phrase of the compact. Writing the book must have been a labor of love, for it seems unlikely to attract the multitude as readers. Yet the subject deserves full study by all citizens of reflective bent, for probably never in the world's history has a negotiation of just the kind of the Colorado River compact negotiation been attempted. Its nearest analogue, perhaps, is to be found in those treaties between nations—and a great many treaties have been of this character—which undertook to adjust economic claims upon joint natural resources, rather than political claims and differences. While treaties of that kind have commonly been framed by the aid of political domination, here the negotiating parties would appear to have been on precisely even footing and free from compulsion.

As a matter of fact, however, Professor Olson's analysis suggests that this particular negotiation was quite as political (as contrasted with judicial) as any treaty in history. They were bargaining, shrewdly and tenaciously, for what they conceived to be local advantage. And as to the outcome, the author says in so many words that concerning all the important points at issue in the discussion of contending claims, the upper half of the basin, or in effect the state of Colorado, gained its point at every turn, while the Arizona representation, with little or no aid from California and Nevada, its downstream neighbors, fatuously managed to yield everything and gain nothing.

Although it is recorded by the author how the official representative of the United States, conservator of the interests of the nation as a whole in the resources of the Colorado Basin, signed the document, "Approved, Herbert Hoover," he perhaps does not forcibly enough emphasize that the nation at large has a deep interest in the adjustment of the Colorado River question, and, as a corollary, that it is entitled to an *equitable* adjustment rather than merely any adjustment that could be put across. On this view any defect of equity in the resulting document may be charged to the federal representation on the commission which signed the document, rather than to the jockeying state delegations.

Professor Olson, a student of law, might be expected to deal with the technical facts less expertly than with the legal, and such is the case. That the Imperial Valley's risk of submergence exerted pressure toward an adjustment of the Colorado question, that the possibilities of water and power utilization in Arizona are very involved, and that the mutual position of California and Arizona was significant, are points not fully illumined. Yet, since California's appropriation of Colorado River water has an anomalous position in Western water law; since the Colorado River compact would have strengthened the legality of this appropriation; and since the Imperial Valley appropriation goes a long way toward exhausting the Lower Basin allotment under the compact as framed, there is a situation of engineering character which may largely account for the hopeless minority position of Arizona in the negotiation.

It is also an interesting fact that while the author repeatedly mentions the contributions of water made by the different states, as credit items of some kind in their account with the river, he does not mention the drainage service derived by those same states from the river, as debits to their account. The non-technical mind is less ready to appreciate that sewerage is a necessary and costly service than that water supply is worth paying money for.

One feature of the book that will be widely appreciated and will make it valuable to many who are not directly concerned with the compact is its discussion of constitutional questions, partly those relating to federal and state power in the matter of navigable streams and partly those relating to interstate water obligations as defined in the Wyoming-Colorado case (decided by the U. S. Supreme Court after the compact negotiations had begun). This part of the book is the more interesting in connection with the queer contention made by Arizona for some years past that while the United States may own the banks of the Colorado through that state, the state nevertheless owns the river bed and the water, so that either state or nation, whichever is most obstinate in maintaining a deadlock, can exort its own terms in any development project. These constitutional and juristic questions, of course, have great importance even outside the Colorado Basin and outside the arid West.

Roughly, Professor Olson's analysis of the subject is made up of a historical review of the compact negotiations, the underlying engineering facts, the economic background of the rival claims of the states, the terms of the compact itself and their application, legal questions at issue in the matter, and the proposal that a Colorado River authority be instituted to deal with river rights and their allotment. This last constitutes Professor Olson's essential contribution to thought on the subject—aside from his devoted labor in compiling the matter which precedes. Concerning it, therefore, any discussion in this place is undesirable as it may tend to deprive the reader of the pleasure of studying the proposal in its original expression, and reading the arguments in its support.

Port and Harbor Conditions of New York

THE PORT OF NEW YORK, In Three Parts: Part I, General Report; Part II, Piers, Wharves and Docks (Statistical Data); and Part III, Atlas of Port Facility Maps, with Index.—Prepared by The Board of Engineers for Rivers and Harbors, War Department, In Co-operation with the United States Shipping Board . (Port Series No. 20.) Paper; Part I, 6x9 in., pp. 384; Part II, 6x9 in., pp. 621; Part III, 18x10 in., pp. 12 and 56 plates; halftones, charts, plates and tables in Part I, statistical tables in Part II, and index with plates in Part III. $2.25 from Superintendent of Documents, Washington, D. C.

A welcome addition to the series of reports on the Ports of the United States is "Port Series No. 20, the Port of New York." These reports are being prepared by the Board of Engineers for Rivers and Harbors in co-operation with the U. S. Shipping Board. Sixteen have now been published; Nos. 12, 15, 16 and 18 are not yet completed for distribution. The New York report is published in three sections, as noted above.

Like its predecessors, the New York report gives full information concerning port and harbor conditions, customs and regulations, services and charges, available services such as dry docks, ship repair plants, fuel supplies, grain elevators, and floating equipment, railroad and steamship lines and their charges and practices in connection with the terminal. Some idea of the magnitude of the port is given by the fact that the report lists in all 868 piers, 56 ferry landings, 93 car float bridges, 57 shipbuilding, dry dock and repair plants, 626 bulkheads, and 184 shore wharves.

Even for any one not especially interested in shipping at New York, but having to do with its vast waterfront area or numerous channels, the atlas of maps alone will be of great value because it gives details which cannot be found on commercial maps of the area.

Fresh Presentation of an Old Problem

THE NEW LEADERSHIP IN INDUSTRY—By Sam A. Lewisohn, Vice-President, Miami Copper Co., Chairman of the Board, The American Management Association. New York: E. P. Dutton & Co. Cloth; 5x7¼ in.; pp. 234. $2.

Written in sympathy with both management and labor and with an eye ever open to production as essential to both, this volume is a worthy addition to the many books on the labor problem that have come from the press in the last few years. The author first clears the way for sane thinking by chapters on The Football of our Emotions and The Capitalistic Obsession, showing in the latter that many of the offenses laid to capitalism are really chargeable to the traits that show themselves in most human beings clothed with authority. Exposition of this idea is continued in the next chapter, Mental Hygiene of Employers, in which two of the topics are natural autocracy of leadership and class consciousness of employers. From these topics there is a natural transition to The Education of the Manager. Other chapters deal with Employer's Responsibility to the Community, Employees Representation as an Aid to Management, Harmonizing Unionism and Industrial Effectiveness—which the author realizes is no light task—The Modern Employer's Wage Policies, which is one of the most significant in the book, and The New Leadership.

Three things the worker wants are said to be Justice, Status, Opportunity. The real difficulty to better relations between labor and management is briefly but forcibly characterized by the single word Neglect—of the vital problems confronting managers and the employing class generally.

The American Management Association, of which Mr. Lewisohn is board chairman, is mentioned from time to time but is modestly kept in the background. The book needs only a wide reading to be a great aid in establishing better relations between the employing and employed classes and breaking down the extreme class consciousness and antagonism that work deadly injury to both. Engineers will appreciate the recognition the author gives them as trained industrial leaders, but with emphasis on the need of education in dealing with men to supplement what the schools give them on dealing with the physics and other material elements of production.

Transportation Study and Research

TRANSPORTATION: A Survey of Current Methods of Study and Instruction and of Research Experimentation. Being a summary of the results of a field investigation into the present status of transportation study and research as disclosed by an examination of typical schools, colleges, universities and research institutes, as well as of corporate, public and governmental agencies concerned with transportation; Prepared for the use of the Committee on Transportation of Yale University—By Victor Topping, M.A., C.E., and S. James Dempsey, M.A., Strathcona Fellows in Transportation in Yale University. New Haven, Conn.: Privately printed for the Committee on Transportation, Yale University. Paper; 6x9 in.; pp. 179.

About two years ago Yale University undertook to formulate "plans whereby the work in transportation, both graduate and undergraduate, might be brought to a definite focus with due regard to the co-ordination of such work as was then offered and such as it might seem desirable to add to the existing program." A survey in the field of transportation in its relation to research and to educational instruction was then undertaken. Mr. Topping and Mr. Dempsey, both holders of the Strathcona Memorial Fellowship in Yale, began active inquiries into the field. This book is the result of that investigation.

The authors interviewed a great many people concerned with transportation in the United States. They were trying to find out what the transportation industry wanted in the way of raw human material and how that material might be prepared by a university to meet such needs. Taken all in all, the result of the survey is somewhat depressing. The authors find that the transportation industry does not very well know just what it does want in the way of human material. It is inclined to believe that it must accept what comes to it and that there is great difficulty in preparing a man specially for this particular field. However, the authors are not downhearted to the extent of abandoning the hope of instruction entirely and have outlined some of the essentials as they see them of instruction in transportation and of programs in research. Their book ought to be of great interest to all railroad men who have gotten beyond the lower rank. Certainly, it should be of value to every university faculty that is looking ahead in its preparation of curricula.

A Notable Revision

THE GOVERNMENT OF AMERICAN CITIES—By William Bennett Munro, Ph.D., LL.B. Jonathan Trumbell Professor of American History and Government, Harvard University. Fourth Edition. New York: The Macmillan Co. Cloth; 5x8 in.; pp. 491.

In the fourteen years since this book first appeared, municipal government in America, like all things, has seen may changes. To meet these and some changes in viewpoint the author has rewritten and enlarged his book. Seldom is such a task so well done. The volume as it now stands bears scarcely an indication that it is other than an entirely new effort.

The scope of the volume as it now stands may be stated in the author's own words: "The book presents an historical outline of American municipal govern-

ment, explains the relation of the city to the state, describes the different forms and organs of administration, treats of the legal powers of the city as a municipal corporation, examines municipal administration as a business proposition, suggests some criteria for judging whether the government of a city is good or bad, and describes in detail the government of four large American cities."

As is fitting in a book for school and general use, the author presents the advantages and disadvantages of the various plans and elements of government that he describes, basing his conclusions not merely on the theory of government but also on how the various schemes have worked in actual practice.

One of the greatest merits of the book is that, without evidence of haste or omission and notwithstanding new chapters, it is a relatively small volume, under five hundred pages, including a good index. The book deserves, as it doubtless will continue to have, a wide use in schools and universities and thousands of readers besides. If the latter were to include every city official in the land, which is far too much to hope, our municipal government would be greatly improved.

Philosophy of Engineering Activity

REVIEWED BY I. GUTMANN
Civil Engineer, New York City

BETRIEBSWISSENSCHAFT, Uberblick über das lebendige Schaffen des Bauingenieurs—Von Dr.—Ing. Max Mayer. Berlin, Germany: Julius Springer. Boards; 7x10 in.; pp. 219; 31 halftones and line cuts. 16.5 reichmarks in Germany.

Scientific management and standardization are as much in vogue in Germany as in this country. A nation as fond of system and method as the Germans are would naturally offer a fertile field to these movements. Furthermore, to pre-war Germany with its military ambitions, standardization appeared a first requisite to national efficiency in time of war and was therefore greatly encouraged and to a large extent enforced by the government in transportation and industry. It is not surprising, then, that the American founders and pioneers of these movements—Taylor, Barth, Gilbreth and others—have found in Germany not only translators of their main works, but also many talented followers who produced a rich original literature, which in some branches offers greater specific detail in more available form than the corresponding manuals published in America. I have particularly in mind the handbooks of Hütte (Betriebs-Hütte) and Prof. H. Dubbel (Taschenbuch für den Fabrikbetrieb), both of them collective works by groups of experts.

While most of the German works on scientific management deal with the problems of the industrial plant, Dr. Mayer's book on the "Science of Management," which is here reviewed, treats particularly of the work and management problems of the construction engineer. The book is one of the monumental series of engineering text (27 volumes) edited by Prof. Robert Otzen of the Technical College of Hannover. Roughly, the first half of the book is devoted to a rather abstract general discussion of scientific management, industrial psychology and allied subjects, of which Taylor, Harrington Emerson and Munsterberg wrote in a more concrete fashion. The other half illustrates the application of the general principles to engineering construction and also takes up contracts, organization, labor relations, advertising, etc. Apparently this more practical half is essentially the chapter contributed by the author to Doctor Foerster's Taschenbuch für Bauingenieure (Berlin, 1921). This part will not sound particularly new to one familiar with the works of Taylor and Gilbreth.

The first half of the book has a tendency to degenerate into eloquent generalities of the type which one may find in sociological writings of the more popular brand. The vastness of the topics of some of the subchapters—Human Characteristics, The Individual, The Roots of Human Behavior, etc.—is well nigh fatal. Still, the author often manages to bring in interesting and stimulating discussions which may be refreshing to a hard-boiled engineer sunk deep in narrow practical detail.

A particularly interesting subject well worth studying is the author's discussion of Freudian psychoanalysis as a means of increasing personal efficiency. It sounds very plausible that an analysis of subconscious fears and obsessions to which practically all of us are subject is bound to release great mental and spiritual energy fit for useful, creative employment. It is interesting to note here that the late Carleton H. Packer, of the Department of Economics of the University of California, discovered the importance of psychoanalysis some years ago when studying the causes of labor unrest in California. Starting with the premise that the "wobbly" was primarily a "jobless, voteless and womanless" individual, Professor Packer arrived at some very interesting practical conclusions.

The scope and general thesis of Doctor Mayer's book are undoubtedly interesting. It would gain much by being less abstract and by displaying more contact with actual red-blooded experience.

For Those Who Design Port Facilities

PORTS AND TERMINAL FACILITIES—By Roy S. MacElwee, Ph. D. Commissioner of Port Development, Charleston, S C. Second Edition, enlarged and rewritten. New York and London: McGraw-Hill Book Co., Inc. Cloth, 6x9 in.; pp. 446; 276 halftones and line cuts. $5.

Eight years ago the author, called into the national service, hastily gathered together his notes and data upon which his course of lectures at Columbia University had been based and prepared the first edition of this book in order that the information which he had collected might be more readily available at a time when port construction work was very active and data on the subject difficult to find. The result, as the author indicated at the time, was nowhere near as complete as he would have liked it to be. Consequently, when he came to revise his work of 1918 in order to bring it up to date and add to it much information which he had gathered in the intervening years, he determined to present the subject matter in two volumes, the first called "Port Development," published in 1925, and now in a second edition, a remarkably fine volume dealing with the factors which affect any port as a unit in the world's transportation system, and the second, the book which is the subject of this comment, "Port and Terminal Facilities," which deals with the details of port design and marine terminal equipment. Material brought to this latter book from the first edition has been entirely rewritten and considerably added to. A brief outline of its contents is best given by the titles of some of its chapters: General Characteristics of a Well Co-ordinated Seaport; Wharf Design—Quay Piers and Other Types; General Cargo Transfer—Winches, Derricks, Cranes, Conveyors; the Transit Shed and Equipment; Marine Terminal Track Arrange-

ments and Drayways; the Port Terminal Warehouse; Ocean Passenger Terminals; Bulk-Freight Ore, Coal, Liquids and Grain; and the Industrial Harbor and Upland Development.

Existing ports—with most of which the author is personally familiar—are used to illustrate various types, and in most cases the author points out wherein the features of these various ports could be improved upon. Many of the points he raises are controversial, but as the author favors the argumentative method of presentation, it is quite probable that he has criticised many features in order to stimulate discussion. Illustrations are used freely to avoid tedious descriptive matter. Also, there are many valuable tables.

With the recent increase of interest in port construction which has come about since the slump in shipping which followed the war, this book will be welcomed by many engineers faced with marine terminal problems.

(The first edition of "Ports and Terminal Facilities" was reviewed in our issue of Sept. 19, 1918, p. 549, and the first edition of "Port Development," June 18, 1925, p. 1027.)

The Delaware River Bridge

THE BUILDING OF THE DELAWARE RIVER BRIDGE CONNECTING PHILADELPHIA, PA., AND CAMDEN, N. J.—By Charles Carswell, Assistant Engineer, Delaware River Bridge Joint Commission. Burlington, N. J.: Enterprise Publishing Co. Paper; 8 x 11 in.; pp. 68; 88 halftones and line cuts. $1.

In an excellently written monograph, Charles Carswell, an assistant engineer on the staff of the Delaware River Bridge Joint Commission, describes the great work of building the suspension bridge between Philadelphia and Camden. His book has the advantage of being written by one gifted with unusual ability to tell an involved technical story clearly as those who have read Mr. Carswell's contributions to the columns of *Engineering News-Record* know. In the present book his graphic style is particularly effective. General planning, preliminary work, foundation construction, erection of the towers, spinning of the cables and, in short, all parts of the work are set forth in surprisingly plain and yet brief recital. Being not merely clear and easy reading, but also a technically correct statement, the monograph will prove equally valuable to the professional engineer and to his lay friend, whether merchant, minister or manufacturer.

PUBLICATIONS RECEIVED

THE FLOOD OF MAY, 1925, in the Murrumbidgee River, believed to be the greatest flood since white settlement of the country, is described in a reprint from the Annual Report of the Water Conservation and Irrigation Commission, New South Wales (Sydney, N. S. W.). A calculation indicates that the precipitation on 5,000 sq.mi. of drainage area above the Burrinjuck dam was about 1,710,000 acre-ft. for the four days May 26-28, or an average of about 6¼ in. Tables, diagrams and halftones are included in the reprint.

A BLUE BOOK issued by the Irrigation Branch of the Government of Punjab, entitled "Technical Review, 1925," contains extensive discussions of research work on river discharge. The leading paper, by W. G. Quinton, executive engineer, is discussed by some 20 British and native engineers. There are, in addition, many "notes" by various engineers on such subjects as gagings in relation to wetted perimeter, current meters, silt and velocity experiments, channel design, and waterproof linings for canals. (14s. from Superintendent, Government Printing Office, Lahore, The Punjab.)

A BRIEF REPORT on the St. Lawrence-New England earthquake of February 29, 1925, has just been issued in mimeograph form by the U. S. Geological Survey. The study was made by Arthur Keith, geologist. The St. Lawrence disturbance is described as one of a series of earthquakes in the northeastern part of the continent between July, 1924, and March, 1926, being the most severe of the group, however. The region of violent disturbance was along and north of the St. Lawrence River. The origin of the earthquake is attributed to the tilting of rock beds of the affected area subsequent to the glacial period.

A CONTINUATION of Rainfall in New England is contributed by X. H. Goodnough, chief engineer Massachusetts State Board of Health, to the June *Journal* of the New England Water Works Association, supplementing earlier data and comment in the same publication for September, 1915, and June, 1921. The present compilation covers the years 1921-25 for stations previously reported and all available records for some new stations, making a total of 337 stations, including 31 in New York State. The figures are given by months and for each year, with averages for the entire period—sometimes scores of years—of observations in each case. Canadian figures, by years only, from 1919 to 1925, are given for 12 stations in Quebec, New Brunswick and Nova Scotia. (For single copies of the *Journal* send $1.25 to New England Water Works Association, Tremont Temple, Boston, Moss.)

THE U. S. COAST & GEODETIC SURVEY has added to its valuable series of publications of geodetic data by states a 78-p. paper on First-Order Leveling in Oregon by Henry G. Avers, Mathematician. While engineers outside the federal and state services may seem slow in utilizing the large amount of horizontal control data which have been made available in the triangulation and traverse executed by federal surveys, they have been eager to utilize the vertical control established by those surveys. This vertical control has for its datum of reference mean sea level, the one surface which is universally constant and co-ordinate. This pamphlet contains the descriptions and elevations (in both feet and meters) of some 1,200 permanent benchmarks in Oregon, the results of first-order leveling by the U. S. Geological Survey, the Coast & Geodetic Survey, and other co-operating organizations and individuals. (15c. from Superintendent of Documents, Washington, D. C.)

New Books and Revised Editions

[*Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.*]

DER GUSSBETON UND SEINE ANWENDUNG IM BAUWESEN—Von J. Gaye. Wesermünde, Regierungsbaurat; Unter Mitarbeit von A. Sturm, Oberingenieur, Munchen. Berlin: Wilhelm Ernst & Sohn. Paper; 7x10 in.; pp. 207; 232 halftones and line cuts. Paper, 15.6, cloth, 16.8 reichmarks, in Germany.

THE LIGHTNING GRAPHS, SERIES I, GENERAL: Designed and Drawn for the Use of Engineers, Physicists, Architects, Surveyors, Draughtsmen and Students—By I. S. Dalgleish, A.M.I.E.E. London: Crosby Lockwood & Son. Cloth; 7x10 in.; pp. 28. 5s. net.

THE LOG LOG SLIDE RULE: A Self Teaching Manual with Tables of Settings, Equivalents and Gage Points—By William E. Breckenridge, A.M., Associate in Mathematics, Columbia University New York: Keuffel & Esser Co. Paper; 5x8 in.; pp. 131; 88 line cuts. 50c.

STEEL BRIDGE WEIGHTS, Being Particulars of 133 Examples with Diagrams Based Thereon—By W. H. Thorpe, A. M. Inst. C. E. London: Crosby Lockwood & Son. Cloth; 10x8 in.; 35 pp. including 16 pp. text, 10 full-page plates; two tables of data on 133 bridge structures. 7s. 6d. in London.
Brief explanatory text and diagrams and tables mostly reprinted from London *Engineering*, the whole presenting much information in little space.

TASCHENBUCH FÜR INGENIEURE UND ARCHITEKTEN—Unter Mitwirkung von Prof. Dr. H. Baudisch, Wien; Ing. Dr. Fr. Bleich, Wien; Prof. Dr. Alfred Haerpfer, Prag; Dozent Dr. L. Huber, Wien; Prof. Dr. P. Kresnik, Brünn; Prof. Dr. h.c. J. Melan, Prag; Prof. Dr. F. Steiner, Wien; Herausgegeben von Ing. Dr. F. Bleich und Prof. Dr. h.c. J. Melan. Vienna: Julius Springer. Cloth; 5x8 in.; pp. 705; 634 line drawings and one plate; mathematical and structural tables, index.

WASSERBAU UND VERWANDTE ANWENDUNGEN: Uferbefestigungen; Schleusen; Wehre; Talsperren; Leuchttürne und Leuchtbaken, Hellinge; Schiffe und Schwimmkorper—Von O. Lienau, E. Marquardt, F. W. Otto Schulze und B. Kressner. Dritte Auflage. [Vierter Band des Handbuches für Eisenbetonbau—Herausgegeben von Dr. Techn. F. Empberger Oberbaurat in Wien.] Berlin: Wilhelm Ernst & Sohn. Cloth or paper; 7x11 in.; pp. 489; 1,200 halftones and line cuts. Cloth, 39, paper, 36 reichmarks, in Germany.

Letters to the Editor

A FORUM FOR DISCUSSION OF VIEWS OF ENGINEERS AND CONTRACTORS

Can Steel or Concrete be Erected More Rapidly?

Sir—In your issue of Aug. 19, p. 313, you published a letter from C. A. P. Turner under the heading "Can Steel or Concrete Be Erected More Rapidly." Mr. Turner refers to the Fort Snelling-Mendota bridge as an example of rapid concrete construction, which it is.

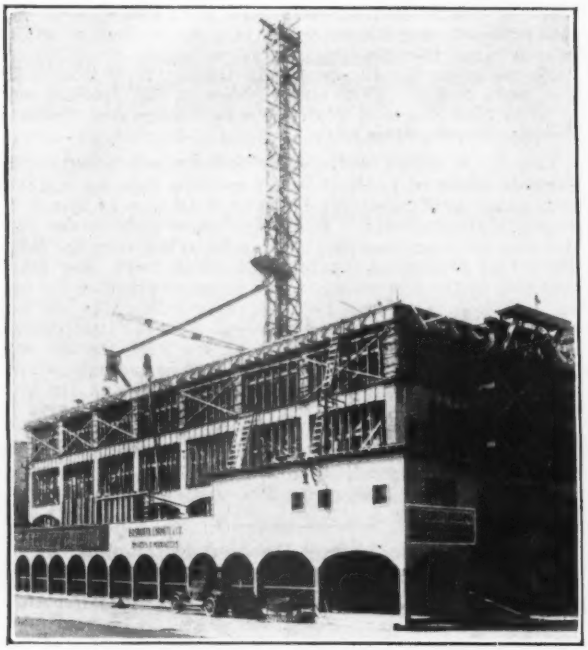
However, two sets of plans and specifications were prepared for the Fort Snelling-Mendota bridge: One, the reinforced-concrete design which is being constructed; the other, a steel deck truss on concrete piers with concrete floors: and bids were advertised for on both sets of plans. Two of the bidders submitted bids on the steel design and also on the concrete design. The successful bidder, Koss Construction Co., did not submit a bid on the steel design. The time of completion specified by the Koss Construction Co. was 30 months after contract was approved, which makes their completion date Sept. 26, 1926. The next low bidder submitted a bid on both designs and specified date of completion for the bridge built according to the reinforced-concrete design, Oct. 15, 1926, and for the bridge built according to the steel design, Jan. 1, 1926, or 9½ months less time for the steel bridge than for the concrete bridge. The other bidder who submitted bids on both the concrete design and the steel design specified date of completion for the bridge built according to the reinforced-concrete design, Dec. 31, 1925, and for the bridge built according to the steel design, Oct. 1, 1925, or 3 months less time to complete the bridge on the steel design than on the concrete design.

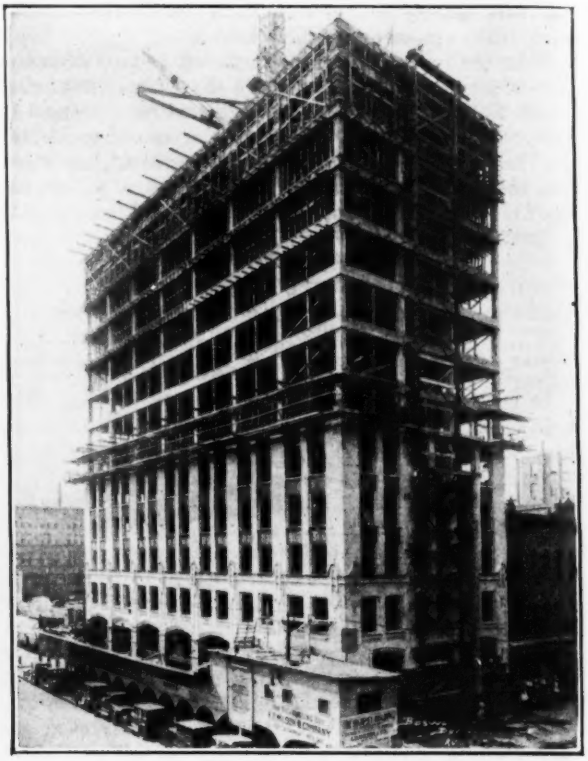
Mr. Turner's letter apparently refers more especially to buildings. The inclosed photographs of the Security (Bosworth-Chanute) Building, Denver, Colo., illustrate very graphically the speed in construction which can be made on reinforced-concrete buildings. This building is 50 x 125 ft., with 12 stories, basement and sub-basement, and two-story pent house. One photograph, taken June 25, 1926, shows the first pour of concrete under way on the 4th floor. The other photograph was taken Aug. 17, 1926, 7½ weeks later than the first photograph, and shows the masonry wall completed up to the sixth story. This progress was made working six days a week and without working nights. In the 7½ weeks elasped time, concrete work for 10 stories of the building was completed and 5 stories of the masonry work on the exterior walls. The writer is designing and consulting engineer on the Security Building.

It is the writer's experience that 12- or 14-story buildings can be erected and completed as rapidly using reinforced-concrete frame as such building can be constructed with structural-steel frame, fireproofed.

WALTER H. WHEELER.

Minneapolis, Minn.
Aug. 27, 1926.





SECURITY BUILDING, DENVER, JUNE 25, 1926, AND SAME BUILDING SEVEN AND ONE-HALF WEEKS LATER

Third Avenue Bridge at Minneapolis

Sir—We note in your issue of Sept. 2 the interesting resumé regarding "Six Concrete Bridges at the Twin Cities." Reference is made to the two earlier bridges and it is stated that, "both these structures were designed and built by the late Frederick Cappelen, as city engineer of Minneapolis."

This statement is incorrect because the Third Avenue Bridge, being the first and pioneer bridge, was designed by the Concrete Steel Engineering Co., New York City, under the writer's personal direction and was built by the city of Minneapolis by day labor. Mr. Cappelen, as city engineer, was in direct charge of the execution of the work and the Concrete Steel Engineering Co. acted as supervising engineers with Charles F. Bornefeld on the work in the capacity of resident engineer.

With the exception of changing the railing detail from panels to balusters and substituting a different kind of lamppost, Mr. Cappelen had nothing to do with the design of the bridge proper. In the approaches, he forced the adoption of plate girders, over our protest, in substitution for reinforced construction proposed in our plans. Our work included the investigation of foundations and we had charge of the extensive program of core-borings which led to the adoption of the curved center line of the bridge.

New York City, Sept. 3, 1926.

WILLIAM MUESER,
Concrete Steel Engineering Co.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

WASHINGTON NOTES

ESTIMATES of the cost of raising the bridges over the New York barge canal are to be made by the board of engineers, of which General Herbert Deakyne, the assistant chief of engineers, is chairman.

The board also is calling upon numerous persons, familiar with the situation, to submit their views as to the possibility of increasing the carrying capacity of the railroads across New York state. Estimates will be made of the volume of traffic which will have to be moved twenty-five years hence.

A digest of the testimony on the Lakes-to-Hudson waterway taken last spring before the Board of Engineers for Rivers and Harbors and before the Committee on Rivers and Harbors of the House of Representative, now is being made for the board. The board expects to sit frequently as a large amount of work must be done before Dec. 9, when its report must be presented to Congress.

RIGHTS of the New River Development Co. have been purchased by the Appalachian Electric Power Co., of Richmond, Va. The latter company has applied to the Federal Power Commission for a license covering a development on New River near Radford, Va. It is proposed to construct a dam 110 ft. high and provide a reservoir 19 miles long covering 4,000 acres. The primary power which thus will be made available amounts to 10,176 hp. It is planned, however, to install four or five 20,000 hp. units.

This development has been the subject of controversy for many months. The New River Development Co. contends that the project does not come within the purview of the Federal water power act. The engineers of the Federal Power Commission took an opposite view. The first examination made by the Chief of Engineers of the army sustained the power company. After vigorous protest had been made by the Governor of West Virginia, a more detailed study was made by the army engineers, with the result that the Chief of Engineers held that navigation in the Kanawha River would be effected by the development.

The Appalachian company submitted its application for federal rights subject to withdrawal if the Federal Power Commission should find that the interest of interstate commerce were not involved.

FOUR 20,000 hp. units instead of three are to be installed at the Grand Falls development of the International Paper Co. at New Brunswick, Canada. Changes also have been made in the intake plan. Work on the substructure of the power house is progressing rapidly and will be completed by the end of the working season.

The development involves 112,250 cu.yd. of rock excavation and 10,600 cu.yd. of earth excavation.

Engineering Fifty Years Ago

From *Engineering News*, September, 1876

THE Chicago Common Council is now wrestling with the gas question. As the cost of the city lamps is something over half a million per year, the subject is one of importance.

* * *

The work of constructing a bridge across the Hudson River at Poughkeepsie, New York., will commence next week. Nearly $200,000 worth of lumber has been contracted for to build the first caisson, and stone has been purchased for the first pier.

* * *

The old wooden bridge over Dale Creek gorge, on the Union Pacific Railroad has recently been replaced by an iron trestle under the direction of William Cliburne, Ast. Eng., Union Pacific. The gorge is 125 ft. deep and 500 ft. wide, and the iron truss bridge is of 13 spans 40 ft. in length, supported on iron columns 111 ft. high. The iron work has been erected in less than 7 weeks and without the detention of a single train. The wooden trestle was by no means in a dangerous condition, the risk from fire being the cause of removal. We believe the iron work was constructed by the American Bridge Co. of Chicago.

50 Mile Railway Authorized

The Interstate Commerce Commission has authorized the Meridian & Bigbee Railway Co. to construct a new railway line from a connection with the Gulf, Mobile & Northern Railway at Meridian, Miss., through Laudardale County, Miss., and Choctaw and Marengo Counties, Ala., to a connection with the Louisville & Nashville Railway at Myrtlewood, Ala., a distance of approximately 50 miles. The cost of construction is placed at $1,326,000. The commission, in its order, has stipulated that construction begin before Dec. 31, 1926, and be completed before Dec. 31, 1929.

Only American Steel to Be Used in N. Y. Subway

New York City Board of Transportation Will Not Permit Use of Foreign Steel

The Board of Transportation of the city of New York has announced that despite the urgings of contractors, it has declined to approve of the use of foreign fabricated steel for the subways now under construction. Contractors have asked that German and Belgian made steel be utilized in the construction of the new rapid transit system.

In withholding approval of the proposal, the board points out that most of the foreign steel is known in the trade as "hard grade steel," whereas the quality required for subway construction in this city is "open hearth steel."

One reason advanced for rejecting the offer is that the Board of Transportation does not wish to unnecessarily invite foreign made steel here. Another reason is that expert inspection of the foreign made material would necessitate the employment and maintenance of steel inspectors in the foreign mills. Contractors have offered to defray the added expenses of foreign inspection and maintenance of American inspectors at the mills abroad.

New York City within the next two years will require 400,000 tons of steel for its subway building program. To date, about 75,000 tons of steel have been contracted for on the subway construction sections now under way. On one of the subway contracts now under construction, the Board of Transportation, in hope of reducing costs, segregated the steel items from all the other items and asked for independent bids from steel manufacturers in this country. Only three bids were received from steel fabricators, and one of the leading steel mills that supplies most of the steel to subway builders did not bid at all.

According to the board some of the elements which make it possible for German and Belgian steel mills to undersell the American manufacturer are: low freight rates, low canal rates in Europe, cheaper labor abroad for the same class of work, low overhead and selling costs and lower costs of fabricating plants.

The most recent subway construction contract awarded by the Board of Transportation contained an item for 3,000 tons of steel at $115 a ton. The average price however varies between $120 and $125 a ton.

The Board of Transportation states that it is determined to adhere to its policy of using only American made steel, unless unit item prices for home-made articles are increased to a point where foreign competition must have to be considered as a matter of self protection against unwarrantably high bids for domestic products.

L. A. Downs Becomes President of Illinois Central

Lawrence A. Downs, president of the Central of Georgia Railway, a subsidiary of the Illinois Central Railway Company, has been appointed president of the Illinois Central Railway to succeed Charles H. Markham, who becomes chairman of the Board of Directors on September 15. Mr. Downs was born at Greencastle, Ind., May 8, 1872, and graduated in civil engineering from Purdue University in 1894. In 1896 he entered the service of the Illinois Central Railway as a rodman and two years later was appointed a roadmaster. This position he held continuously until 1907 during which period he was in charge of grade reduction work, double tracking and terminal construction. In 1907 he was appointed assistant chief engineer, maintenance-of-way; in 1910 he became a division superintendent, in 1915 a general superintendent, in 1919 assistant to general manager and the following year became vice-president and general manager of the Central of Georgia Railway.

Mr. Markham has relinquished the presidency of the road on account of his health which has been broken down by his concentration upon the Illinois Central electrification work at Chicago.

Army Completing Plans for New Buildings at Military Posts

The office of the Quartermaster General of the United States Army is now completing plans for constructing new barracks, hospitals and officers' quarters at 17 military posts. It is expected that construction will be started this fall, so that the work can be completed next summer. A total expenditure of $7,020,000 is to be made.

The largest expenditure is to be made at Camp Lewis, Wash., where $800,000 is to be spent for the construction of barracks and $125,000 for the beginning of a hospital. Other large items are $450,000 for the completion of a hospital at Schofield Barracks, Hawaii territory, $725,000 for a barracks at Fort Benning, Ga., $655,000 for two barracks and a hospital at Fort Monmouth, N. J., $500,000 each for a barracks at Fort Sam Houston, Tex., at Fort Humphreys, Va., and Camp Devens, Mass., $750,000 for barracks and N.C.O. quarters at Selfridge Field, Mich., about $400,000 each for barracks at Camp Meade, Md., and Fort Bragg, N. C., and about $285,000 each for barracks at Mitchell Field, Long Island, and Fort Wadsworth, N. Y.

St. Louis Subway Reports Ready

Within thirty days the special committee on subways of the St. Louis, Mo., board of aldermen will have the complete report of C. E. Smith, consulting engineer, for a subway system for the city. The report is now being printed. The plan is understood to call for the construction of the project in three stages, with total costs of $40,000,000, $72,000,000, and $100,000,000 for the completed project.

Contract Let for Bridge Over Lake Pontchartrain

Five Mile Concrete Trestle With Two Movable Spans Will Give New Orleans Highway Outlet to East

Contract for five miles of reinforced-concrete trestle work and for the substructures of two bascule spans for a toll highway bridge over Lake Pontchartrain near New Orleans has been let by the Watson-Williams Co. of New Orleans, the franchise holder, to the Raymond Concrete Pile Co., of New York City. The bridge and its approaches will have a total length of about fifteen miles, both approaches connecting with the present state highway system. A franchise was granted to the company by the Louisiana State Highway Commission about a year ago. The bridge will cross the lake at its narrows, from Pointe aux Herbes to near Slidell, and will be parallel to and about ½ mile east of the timber trestle crossing of the Southern Ry. Except for two double-leaf bascule draw spans over the ship channels, the bridge will consist of concrete trestle of 35-ft. spans carrying a 20-ft. roadway. Approach roads of some length are part of the project. The approach from the New Orleans side, 6 miles long, starts from State Highway No. 2 about 11 miles east of New Orleans. Three miles of this approach is over bad marsh land. The north approach is 4 miles long, starting from the state highway near Slidell. The entire project involves $5,000,000 to $6,000,000.

The whole matter of providing for New Orleans a direct highway exit to the east, without recourse to ferries, has been in a complicated political tangle for some time. The issue is toll bridges or free bridges. About two years ago the State Highway Commission was given authority by the legislature to grant franchises for toll bridges on terms satisfactory to itself. Immediately thereafter the Watson-Williams Co. petitioned for a franchise to build and operate a toll bridge in the general vicinity of the location above described, and another syndicate petitioned for a franchise to build a bridge from West End to Mandeville across 22 miles of open water. The first franchise was granted and the latter denied.

About the same time agitation was started by proponents for a toll-free improved highway on the line of the Spanish Trail, following approximately the line of the Louisville & Nashville Railroad. This would require large movable bridges across Chef Menteur and the Rigolets channels, and a small one over Salt Bayou. The project has been estimated to cost about $500,000 for road and $1,500,000 for bridges.

New Water Supply for Oak Creek

Oak Creek, Colo., is preparing to install a modern water system after plans prepared by Burton Lowther, former chief engineer of the Denver Water Board. It will be of one million gallons capacity per day. J. J. Argo is the local engineer in charge.

Railway Roadmasters to Meet in Chicago

Addresses relative to railway track work at the 44th annual convention of the Roadmasters and Maintenance of Way Association, to be held at Chicago on Sept. 21 to 23, will include the following: "Development of Modern Track Construction," J. V. Neubert, engineer of maintenance of way, New York Central R.R.; "Relation of Modern Locomotives to Length of Turnouts," H. J. Pfeiffer, chief engineer, Terminal Railroad Association of St. Louis; "Safety in the Maintenance of Way Department," Thomas H. McCarrow, supervisor of safety, Pennsylvania R.R.; "Care and Selection of Ties," John Foley, forester, Pennsylvania R.R.; "Morale of Maintenance of Way Forces," J. S. Hyatt, general manager, Chicago, North Shore & Milwaukee Ry. An opening address is to be given by R. H. Aishton, president of the American Railway Association, and there will be a talk also by Charles A. Morse, chief engineer, Rock Island Lines. In addition there will be the following committee reports: (1) Repair of track tools; (2) Construction and maintenance of highway crossings, approaches and signs; (3) Track joints and their maintenance; (4) Arrangement of track work to promote uniform forces throughout the year; (5) collection and use of cost data by track supervising forces.

Revised Georgian Bay Canal Scheme Opposed

The Canadian Government has refused to give its approval of the general route plan submitted by the Montreal, Ottawa and Georgian Bay Canal Co. in respect to the Georgian Bay canal. In making the official announcement, Sir Henry Drayton, Acting Premier said: "If the company desires to proceed in good faith with its work of canalization, according to the engineers of the departments of public works and railways and canals no such plan is required, and if, on the other hand, under the guise of navigation, the power resources of the Ottawa River are to be exploited, no such general route ought to be approved."

The general route of the proposed canal is understood to extend from Georgian Bay to Montreal by way of the Ottawa River, and for many years has been urged as a short cut for bringing grain forward by water from the head of the lakes to ocean ports.

Conference on Lake Pollution

At the third annual convention of the Lake Michigan Sanitation Congress, to be held at Racine, Wis., on Sept. 24, it is planned to urge the completion of the joint sewage treatment works for Hammond, Whiting, Gary and East Chicago, Ind., in order to check the present pollution of the lower end of Lake Michigan. Certain Wisconsin cities, will also be urged to undertake sewage treatment. J. A. Henricks, Hammond, Ind., is secretary.

Civil Engineers Meeting to Be Largely Historical

The fifty-sixth annual convention of the American Society of Civil Engineers to be held in Philadelphia, Oct. 4-9, is to be largely of an historical nature as befits the time and place of meeting. Officers of the Sesqui-Centennial Exposition have arranged special features for Tuesday afternoon and evening when the members of the society will be their guests. The convention also will take on an international character in that there will be addresses on One Hundred and Fifty Years of Progress in Civil Engineering by Sir William Henry Ellis, president, Institution of Civil Enginers, London; Louis Baclé, president, Société des Ingénieurs Civils de France, Paris; and George A. Walkem, president, Engineering Institute of Canada. Dr. Karl Wendt, president, Verein deutscher Ingenieure will be represented by Max Krone, general director of electricity and waterworks, Bochum, Germany.

On Wednesday, Oct. 6, there will be meetings of the sanitary engineering, highway, power and surveying and mapping divisions, and on Thursday there will be a joint meeting of the construction and structural divisions and meeting of the city planning and sanitary engineering divisions.

N. Y. Railway Electrification Law Held Unconstitutional

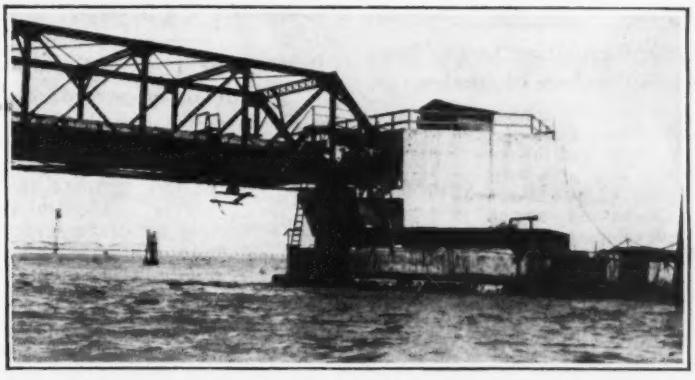
The statutory court, sitting at New York on Sept. 9, declared unconstitutional the amendment to the Public Service Commission law of the state of New York which provides for the electrification of railways in certain cities of the state, known as the Kaufman Act. This act was passed in 1923 and amended in 1924. It provides for the electrification of all railways within the limits of cities "having a population by the last state or federal census of 1,000,000 or more or within the limits of a city adjoining such cities," on or before Jan. 1, 1926. Last year the state legislature authorized the Public Service Commission to extend this time limit not more than five years.

Last December practically all the railroads within the limits of the city of New York attacked the law and obtained an injunction against its being enforced upon the first of January, but with the extension of time granted to the larger railroad companies by the Public Service Commission, in view of the work which they had already done, as noted in our issue of July 22, page 158, and July 29, page 197, these companies withdrew from the action, leaving only the smaller companies, some of which had not received an extension of time from the commission, to continue the action.

The court found that the amendment to the Public Service Commission law was unconstitutional on the ground that it interfered with the federal government's power to regulate interstate commerce in that the government had vested in the Interstate Commerce Commision the right to prescribe what types of locomotive are to be used by the railroad companies.

City Managers Plan Big Meeting

An extended program of papers and round-table discussions is announced for the thirteenth annual meeting of the International City Managers' Association, to be held at Colorado Springs, Colo., on Sept. 21 to 23. Round-table discussions, each to be opened by a set paper, are as follows: "The City Manager and Local Political Groups," "The City Manager and the City Press," I. C. Brower, Lima, Ohio; "Managerial Functions of a City Manager," Earl C. Elliott, Wichita, Kan.; "The City Manager and Improvement Programs," C. A. Ashburner, Stockton, Calif.; "Annual Reports," S. P. Malone, Pawhuska, Okla.; "Problems of the Small City," A. W. Seng, Hays, Kan.; "Financial Department Administration," Eugene Masters, St. Augustine, Fla.; "Budgets and Accounting," E. E. McAdams, Waco, Tex.; "Purchasing," Richard Biehl, Two Rivers, Wis.; "Street Cleaning," W. P. Hunter, Roanoke, Va.; "Training and an Apprentice System," Prof. Thomas H. Reed, University of Michigan. Other papers include: "The City's Shade Trees," Alfred MacDonald, Wichita, Kan.; "Police Department Organization," August Vollmer, Berkeley, Calif.; "Pitfalls of our Profession," Dr. A. R. Hatton, Cleveland, Ohio Entertainment features will include a tour of the city with visits to municipal enterprises. The president of the association is Harrison G. Otis, Clarksburg, W. Va.; secretary, John G. Stutz, Lawrence, Kan.



NEW WATER SUPPLY PIPE LINE ACROSS THE SOUTHERN END OF SAN FRANCISCO BAY

CONSTRUCTION of the first pipe line to cross the southern end of San Francisco Bay for the Hetch Hetchy Water Supply Project has been completed and is being used, pending the bringing in of Hetch Hetchy water, to supplement the pipe lines of the Spring Valley Co. which now serves San Francisco. The lower picture shows the bridge carrying the 60-in. line, beside which is room for a second pipe. The bridge extends from the west shore, a distance of 3,870 ft., to the anchor pier near the ship channel shown in the upper picture. From this pier a 42-in. flexible pipe line has been laid across the channel bottom to the east shore. In the background of the pier picture may be seen the recently completed Dumbarton vehicular bridge. An account of the construction of the submarine pipe crossing appeared in *Engineering News-Record*, March 18, p. 434.

Rapid Progress on Three Bridges at Pittsburgh, Pa.

Fast work is being done on the erection of the group of three self-anchored suspension bridges over the Allegheny River at Pittsburgh now under construction by Allegheny County, according to V. R. Covell, chief engineer of bridges of the county's public works department. Seventh Street bridge, first of the group to be undertaken, was closed Feb. 9 and was opened to traffic a few months later. Using the same method of cantilever erection with the aid of temporary diagonal struts, steel erection on the Ninth Street bridge began March 1; the span was joined at the center Aug. 6, and it will be ready to receive the paving in a short time. The third of the group, the Sixth Street bridge, is to be erected next year.

River Regulation to the Fore in Province of Quebec

The fourteenth annual report of the Streams Commission of the Province of Quebec states that the commission probably will ask authority to start the regulation of the Gatineau River at Lake Daskatong, so as to help the power development now in progress by the International Paper Co.

In view of the lack of power on the south shore of the St. Lawrence River, as compared to the large quantity available on the north shore, the commission is studying the opportunity of regulating the waters of the Riviere du Loup. The same will be done for the Megiscane River and the Batiscan River. The commission has also instructed its engineers to make a survey of the hydraulic development possibilities in the mining district of Rouyn and the upper Ottawa. The project of establishing a reservoir at Makanac, 25 miles north of Grand 'Mere, is practically decided upon, according to the report.

Bridges Over Navigable Waters Listed in New Book

The Corps of Engineers, U. S. Army, has printed in book form a list of bridges over the navigable waters of the United States. More than 5,000 bridges are listed, showing the river; the distance of the bridge from the mouth of the river; the owner; kind and number of spans; the clearance through channel spans; the date the structure was approved by the federal government; the date of completion; the purpose for which the bridge is used, and the time during which draw bridges will remain closed.

The present edition is a tentative one, due to the fact that funds were not available for field work. This compilation was taken from office records and is known not to be entirely accurate or all inclusive. District engineers and others are being requested to check the accuracy of the compilation in the course of their other work, after which an edition which will be printed which will be available for distribution. Only a limited number of the existing work were printed.

Reclamation of Jersey Meadows Subject of Hearing

The Board of Commerce and Navigation of New Jersey will hold a public hearing in Jersey City at 2 p.m. daylight saving time on Wednesday, Sept. 22, 1926, to ascertain the views of all parties interested in the preparation of a comprehensive plan for the reclamation and improvement of the marsh and meadow lands of the State of New Jersey within the Port of New York District.

The Board of Commerce and Navigation was directed by the state legislature in 1926 to make a study and report on the reclamation and improvement of the meadows, and to make its recommendations for the improvement of the waterways, bays, rivers and creeks that will be affected by such reclamation and improvement.

Railway Bridge and Building Men to Hold Convention

At the 36th annual meeting of the American Railway Bridge and Building Association, to be held at Richmond, Va., on Oct. 12 to 14, there will be the following committee reports: (1) Protecting structures over tracks from locomotive blast and gases; (2) motor cars for bridge and building gangs; (3) Pumping equipment for various purposes; (4) Roofing materials for railway buildings; (5) Repairing poor or disintegrated concrete; (6) Protective coatings for structural steel; (7) Creosoted timber for structures; (8) Use of compressed air in bridge and building work. In addition there will be a few papers, including: "Maintenance-of-Way Painting Forces," by L. B. Allen, superintendent of maintenance, Chesapeake & Ohio Ry., and "Framing Bridge Timbers Before Treatment," by Earl Stimson, chief engineer of maintenance, Baltimore & Ohio R.R. The president is C. W. Wright, Long Island R.R., and the secretary is C. A. Lichty, Chicago & Northwestern Ry., Chicago.

First Hetch Hetchy Transbay Pipe Now in Service

Twenty-one miles of pipe line in the bay division of the Hetch Hetchy project, which is to be used ultimately in bringing in Tuolumne River water to San Francisco, is now in service, but instead of conveying Tuolumne River water it delivers water from the Spring Valley watersheds on the east side of the bay to reservoirs on the San Francisco peninsula. A statement of the plan whereby the Spring Valley Water Co. pays interest for the present on the cost of this construction appeared in *Engineering News-Record*, May 4, 1922, p. 751, and an account of the construction of the flexible submarine pipe was published March 18, p. 434. The total expenditure to date on the bay crossing division, including rights of way, engineering, proportion of bond discount, etc., totals about $6,000,000. Mr. M. O'Shaughnessy is city engineer of San Francisco.

Indianapolis Engineers Consider Sewerage Troubles

A committee of the Indianapolis Engineering Society, investigating the controversy between the sanitary board and its engineers as to the new sewage disposal plant (*Engineering News-Record*, Aug. 26, p. 356), has recommended the appointment of an outside engineer to examine the plant in cooperation with the designing engineer and to suggest the additional works necessary to give the desired capacity. Opposition to expenditure for such additions as have been advocated already by the engineers of the plant, is one of the sources of trouble. According to press reports, the mayor has written to the board advising it to settle its internal dissensions.

Navy Opposed to Bridges Over San Francisco Bay

The position of the Navy Department with regard to the proposed bridge across San Francisco Bay, as stated officially, is as follows:

"Existence of a bridge across San Francisco bay north of Hunters Point would be inimical to the national defense, because it would restrict shipping and naval operations in that bay.

"During war the wrecking of such a structure by bombs or an act of nature, might bottle up completely such naval forces and commercial shipping as were in the harbor at the time and these might include the whole fleet.

"If the fleet were at sea it might prevent its entrance into San Francisco bay, thus depriving the navy of a most essential Pacific Coast base. San Francisco bay and Puget Sound are the only protected bases on the Pacific Coast which a fleet can use for refueling, refitting and operation during war."

Gulf Coast Line to Build New Extensions in Texas

The St. Louis, Brownsville & Mexico Railway Co., a subsidiary of the Gulf Coast Line, has applied to the Interstate Commerce Commission for authority to construct an extension of its present main line from near Raymondville, a distance of 18 miles, to a point near the Hidalgo-Cameron County Floodway, in Cameron County, Tex. Funds for the construction are to be advanced by the New Orleans, Texas & Mexico Railway Co., (Gulf Coast Lines).

The San Benito & Rio Grande Valley Railway Co., another subsidiary of the Gulf Coast Lines, has applied to the Interstate Commerce Commission for authority to build two extensions to its railway line, one a 6-mile line from Fernando, and the other an 18-mile line from San Benito to a connection with the Rio Grande Ry.

The New Orleans, Texas & Mexico Railway Co. has applied to the commission for authority to acquire control of the San Antonio Southern Ry., a 40-mile railway with an additional 15 miles of trackage rights over the International Great Northern Ry. from Kirk to San Antonio.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Providence, R. I., Sept. 14-17, 1926.

INTERNATIONAL CITY MANAGERS' ASSOCIATION, Lawrence, Kansas; Annual Convention, Colorado Springs, Colo., Sept. 21-23, 1926.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, N. Y.; Annual Convention, Philadelphia, Pa., October 4-9, 1926.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Meeting, Buffalo, N. Y., Oct. 11-14, 1926.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Pinehurst, N. C., Nov. 8-12, 1926.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Louis, Mo.; Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

THE ASPHALT ASSOCIATION, New York City; Annual Meeting, Washington, D. C., Nov. 8-12, 1926.

HIGHWAY RESEARCH BOARD, OF NATIONAL RESEARCH COUNCIL, Washington, D. C.; Annual Meeting, Washington, D. C., Dec. 2 and 3, 1926.

Opening the season on Sept. 13 with a paper on "The Reduction of Deformation Stresses in Fixed Concrete Arches," describing a method for designing 1,000-ft. concrete arch spans of low rise, by J. F. Brett, the Western Society of Engineers has other subjects announced as follows: "High Pressure Gas Holders," Sept. 20; "Reading and Reproducing Sound," by L. J. Robinson, Sept. 27; "Water Softening for Boiler Feed Water," by C. R. Knowles, Oct. 4; "Acetylene Welding in Industry," Oct. 11; and "Filtration of Municipal Water Supply," by George H. Fenkell, Oct. 18. An excursion to Milwaukee is arranged for Oct. 8, and a demonstration of talking motion pictures for Oct. 25.

The Canadian Good Roads Association will hold its 13th annual convention Sept. 28-30 at Edmonton, Alberta, each of the provincial governments being represented.

The Administrative Board, American Engineering Council, will hold its next meeting at Ithaca, N. Y., Nov. 11-12, 1926.

Personal Notes

A. J. HAMMOND, consulting engineer, Chicago, has been appointed chief engineer of the Mellon-Stuart Co., engineers and contractors, with offices at 111 West Washington St., Chicago.

WILLIAM W. PEABODY, deputy chief engineer under FRANK E. WINSOR of the Providence, R. I., Water Supply Board, has been appointed chief engineer to succeed Mr. Winsor who was selected as chief of the Massachusetts Metropolitan District Water Supply Commission. FRANCIS B. MARSH, formerly designing engineer of the board will become deputy chief and EARL C. CRAIG, an assistant engineer, will become designing engineer.

JOHN P. H. PERRY for the past seven years vice-president in charge of new business for the Turner Construction Co. at its main office at 244 Madison Ave., New York City, will effective October 1 be located in the Chicago office of the Turner Construction Co. as vice-president in charge of operations in the Western territory. Mr. Perry has been with the Turner Construction Co. over twenty years.

G. P. RIGBY has been appointed resident engineer for the New Brunswick Hydro-Electric Commission on the construction of the new Loch Alva dam.

GEORGE G. SCHMIDT, city engineer of Indianapolis, Ind., has resigned to give his time to engineering practice. Before becoming city engineer in 1925 he was head of George G. Schmidt & Co., civil engineers and surveyors and he had formerly served as deputy county surveyor and county surveyor of Marion County, Indiana.

ORA MCDERMITH, consulting engineer on the Kittitas reclamation district in Washington, has been appointed a member of the Reclamation Bureau's Pecos River board. He will retain his office in Ellensburg, Wash., and will continue to represent the Kittitas district, for which he drew up the final plans and which he represented in various government hearings. The other members of the Pecos River board are L. C. Hill of Los Angeles and S. O. Harper of Denver.

ALFRED W. GAUGER has been appointed to take charge of the work of the Engineering and Mining Experiment Station of the University of North Dakota, at University Station, N. D.

PERRY F. SEWARD, assistant district engineer for the North Carolina State Highway Commission in the fourth district, with headquarters at Durham, N. C., has gone to Florida to join F. E. Schaeppfe, formerly chief district engineer in the fourth North Carolina district, in engineering work in Sarasota County, Florida.

H. T. FORD has been appointed manager of public utilities and of the engineering department at Rome, Ga., succeeding GEORGE H. CAIRNS who had held the position sixteen years. Mr. Ford was formerly employed by the Rome Light & Railway Co., and was a construction engineer for the Bush Syndicate at Louisville, Ky.

SAMUEL A. HART, of the city engineering office at Sacramento, Calif., has been made assistant city engineer, succeeding J. E. Tempest who recently resigned. CHARLES R. BLOOD has resigned as assistant maintenance engineer of the California State Highway Department to take the position recently held by Mr. Hart.

MAJOR LAYSON E. ATKINS, Corps of Engineers, until now stationed on construction work at Lexington, Ky., has been appointed to succeed MAJOR WILLIAM H. HOLCOMBE as assistant engineer in the District of Columbia, Major Holcombe having been transferred to river and harbor work in Louisiana with station at New Orleans. Major Atkins graduated from the United States Military Academy in 1915, served with the engineers in the punitive expedition into Mexico and in the World War with the 14th Engineers (Ry.), and since 1919 has served variously in Texas, Washington, D. C., Fort Humphreys and at Louisville.

HENRY B. SEAMAN, for the past two years chief engineer of the Powers-Kennedy Contracting Co., builders of the subway extension of the Queensboro tunnel in New York City has resigned this position and will return to his consulting engineering practice in rapid transit, structural and railway work.

WILLIAM F. SCHWERIN, formerly senior assistant engineer of the Bureau of Engineering of the city of Pittsburgh, Pa., has been promoted to principal assistant engineer of this bureau.

Obituary

FRANCIS W. CHANDLER, formerly for many years head of the department of architecture of Massachusetts Institute of Technology, died at North Haven, Maine, Sept. 8 aged 81 years. Professor Chandler was born in Boston, educated at Lancaster Academy, served in the Civil War, studied architecture and after some years became a member of the firm of Cabot & Chandler, architects in Boston. He served as head of the department of architecture at Massachusetts Institute of Technology from 1886 to 1911, when he retired. At one time he was advisory architect for the city of Boston.

MAJOR E. M. ADAMS, Corps of Engineers, retired, died in Boston, Mass., Aug. 29. Since graduation from the United States Military Academy in 1900 he had served at the Washington Barracks, in New Orleans, in the Philippines, Pittsburgh, Charleston, S. C., and at New York City. He was retired for disability in 1913 but returned to active service during the World War.

JAMES M. STONE, Nashville, Tenn., engineer and contractor on many road paving projects in eastern Tennessee, North and South Carolina and Florida, died in Nashville Aug. 20 at the age of 44 years; he had been in ill health for two years but had carried on his work until recently. Mr. Stone was an engineering graduate of Vanderbilt University.

Construction Equipment and Materials

A SECTION DEVOTED TO WHAT THE MANUFACTURER IS DOING FOR THE ENGINEER AND CONTRACTOR

Welding Equipment to Be Exhibited at Buffalo

In connection with the annual fall meeting of the American Welding Society in Buffalo, Nov. 16-19, an exhibit of welding equipment will be made showing new developments in welding apparatus and supplies. A feature of this exhibit will be the showing of a large variety of welded products. The exhibit will open the day preceding the meeting of the society and will be held in the Broadway Auditorium.

Construction Equipment Exports Continue to Increase

American manufacturers of equipment and materials used by the construction industry have continued their efforts to sell to the foreign customer which began shortly after the war. This is indicated by figures of the Bureau of Foreign and Domestic Commerce shown in the accompanying table. Dr. Julius Klein, director of the bureau, in a recent statement said: "There is every reason to anticipate a steady increase for the future in American exports of manufactured products. They are bound to become gradually a larger and larger share of our total exports."

EXPORTS OF MANUFACTURED ARTICLES
(Values in Millions of Dollars)

Article	1921 to 1922	1924 to 1925	1925 to 1926	Per Cent Increase 1925 to 1926 from 1921 to 1922
Lumber and related products	59.7	97.3	98.9	65.6
Iron and steel (heavy products)	130.3	136.5	157.1	20.5
Copper wire and cable	4.3	5.9	6.3	45.0
Engines, locomotives, waterwheels, etc.	32.0	26.0	27.8	—12.9
Construction and conveying machinery	5.3	10.7	15.9	199.6
Mining, oil-well, and pumping machinery	16.3	24.6	34.5	111.2
Tractors (agricultural uses)	4.5	22.9	42.0	827.8
Motor trucks	6.5	25.0	46.5	612.5

Business Notes

IRVING IRON WORKS CO., Long Island City, N. Y., will hold its national sales convention in the Hotel Astor, New York City, September 20-24. A total attendance of about 100 is expected including the officers of the company, the department heads from the main office and factory, and representatives from 30 sales offices.

C. H. JOHNSON has been appointed engineer, service department of the Timken Roller Bearing Co., Canton, Ohio. He will have direct charge of the installation of bearings in automotive and industrial applications.

KUHLMAN ELECTRIC CO., Bay City, Mich., manufacturers of power, distribution and street lighting transformers, announces the appointment of H. F. Darby, Jr., 1700 Walnut St., Philadelphia, Pa., as direct factory representative in the Philadelphia district. Mr. Darby has been for the last twenty years with the Cutter Electrical & Mfg. Co., for which he has been sales manager during the past six years.

K. H. TALBOT has been appointed manager, cement sales, of the Cowham Engineering Co., Chicago, designers, builders and operators of portland cement plants. Mr. Talbot has formerly been connected with the Universal Portland Cement Co., the Koehring Co., and the Centrifix Corp., Cleveland.

INGOT IRON RAILWAY PRODUCTS CO. announces the removal of its general offices from Chicago to Middletown, Ohio, but a district office will be maintained at 122 So. Michigan Ave., Chicago.

O. G. MANDT, former president and owner of the American Cement Machine Co., is no longer connected with it and has been succeeded by E. J. Kirch, formerly treasurer. Mr. Mandt is now with the Jaeger Machine Co., Columbus, Ohio.

REPUBLIC MOTOR TRUCK CO., INC., Alma, Mich., has opened a direct factory branch at Philadelphia, to be located at 26th and Moore Sts. C. L. Bowler has been appointed branch manager.

MUNDY SALES CORP., New York, announces the following new exclusive distributors for its line of hoists: Bacon Engineering Sales Co., 251 Erie Building, Cleveland, Ohio; Barnett-Dunning, Inc., 143 E. Ohio St., Indianapolis, Ind.; Toledo Sales & Engine Co., 16 No. St. Clair St., Toledo, Ohio.

AMERICAN CASTING CO., BIRMINGHAM, ALA., has adopted a new trade name for its spiral corrugated cast-iron pipe. This product is to be known as "Spicor."

BRISTOL CO., Waterbury, Conn., manufacturers of recording pressure gages, thermometers, pyrometers, etc., announces the opening of a branch sales and service office in Denver, Colo. H. T. Weeks is representative in charge.

CLAUDE F. CHARD, for several years Cleveland district sales manager, Austin Co., Cleveland, was killed in an automobile accident on Aug. 13. As district sales manager, Mr. Chard's territory included southern Ohio, Kentucky and southern Indiana. Mr. Chard was 37 years old. He graduated from Purdue University in 1910 and before his association with the Austin Co. in 1918 was with the Westinghouse, Church, Kerr Co., a construction firm in New York.

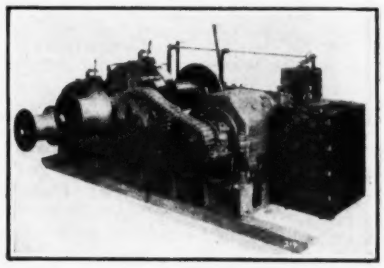
WILLIAM C. BERGMAN, president of the Parsons Co., Newton, Iowa, died August 21.

New Developments

Electric Hoist Changes Speed and Pull by Using Two Sprockets

Two specially built 75-hp. electric double-drum hoists have recently been manufactured by the J. S. Mundy Hoisting Engine Co., New York City. These hoists were supplied with two sprockets so that a change of speed could be obtained by transferring the chain drive from the larger to the smaller sprocket. This was done by removing several links of the chain.

With the chain on the large sprocket the hoists have a line pull of 10,000 lb. at 200 ft. per minute. Using the small sprocket the hoist has a line pull of 7,000 lb. at 300 ft. per minute. The hoist has a drum capacity of approximately 1,500 ft. of rope on each drum



and each machine is supplied with Asbestall frictions, cut steel gears, and air-cooled flanges on both drums. The chain drive runs in an oil-tight case.

The hoists are being used in erecting steel on the Graybar Electric Co.'s building, Lexington Ave. and 43rd St., New York City. The particular advantage in building a hoist in this manner is that it can be used very readily for handling the heavy pieces which are usually on the first two or three floors of a building and then from that point up a faster speed can be used for the lighter pieces. Each machine is raising 600 tons of steel per week, operating continuously from 8 to 12 hr. daily.

Machine Raises Railroad Track for Surfacing Operations

A railway motor car, equipped with a mechanism for raising the track upon which it stands, has been developed by the Nordberg Mfg. Co., Milwaukee, Wis., as an aid to more rapid and efficient surfacing operations.

The machine was originally developed for shifting track in which case a single spud footing on the roadbed between the ties and operated by a rack and pinion raised one rail of the track high enough that the spud became unbalanced, tip-

ping over and carrying the entire track section to a new position. This was described in *Engineering News-Record* Sept. 17, 1925 p. 489.

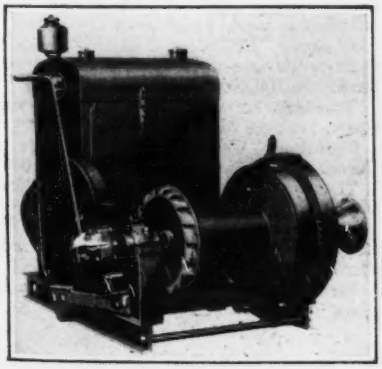
It was, however, difficult to raise both rails at the same time and keep the track balanced when using a single spud. In order to raise both rails at

the same time, there was developed this latest attachment which is known as a leveling device. This can be attached to any standard machine already in the field. The regular foot piece is taken from the lifting spud and a longer one put in its place. At each end of this longer foot piece are the two leveling spuds, the movement of which is controlled by the operator. It is claimed that in too sandy material or wet, sticky material, where it is difficult to obtain a footing, this device can be used where hand jacks would be out of the question. It is possible to raise the track vertically a distance of 3 ft.

Light Duty Hoist Built on Heavy Hoist Principles

Designed for general hoisting work, the new Model NH hoist manufactured by the Novo Engine Co., Lansing, Mich., is said to incorporate several features heretofore found only on heavy duty hoists. In addition, it is claimed to be the first hoist in which a welded tubular frame has been used. Either gasoline or electric power units are supplied, the power range being from 3 to 9 hp. in the gasoline units and from 3 to 7½ hp. for electric motors. The capacities are 600 to 1,600 lb., depending upon the power used and the speed from 110 to 135 ft. per minute. The net weight of the hoist without the engine or motor is 740 lb.

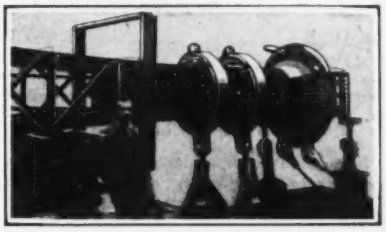
It is a single three-drum type, the drum being 8 in. in diameter and 14 in. long; it is bronze bushed throughout.



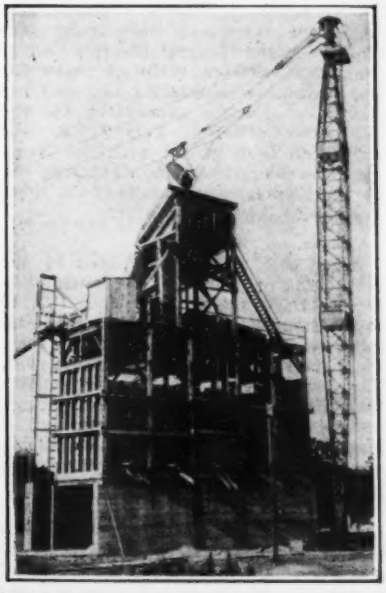
A larger drum, 12 in. in diameter and 14 in. long, may be had at extra cost. Cable capacities are: For the 8-in. drum, 1,250 ft. of ⅝-in. or 700 ft. of ¾-in. cable, and for the 12-in. drum, 700 ft. of ⅝ or 400 ft. of ¾-in. cable. Intermediate and drum shaft bearings are babbitt and are adjustable. All lubrication is by the Dot high pressure grease gun.

New Features on Steel Mast for Slackline Cableway

A recent improvement in the slackline cableway excavator equipment manufactured by Sauerman Bros., Chicago is a new type of steel mast. The body of this mast is of lattice construction, as was the previous type of mast, but the top is of reinforced plate properly cross-braced to equalize the strains of the guy cables and the pull of the operating lines that pass through the sheave blocks attached to the mast top.



The single sheave blocks that guide the operating cables from the power unit up to the top of the mast and thence out to the excavation, are attached to round mast-bands that swivel on steel saddles. This design

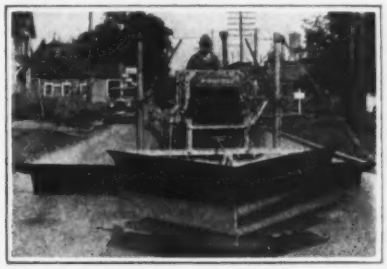


is said to assure a perfect alignment of the blocks at all times. The mast is capped with a swivel plate to which the guy cables are attached and the base of the mast is fitted with a swivel ball-and-socket arrangement. The upper multiple sheave block for tensioning the track cable is so fastened to the top frame work that it turns with the mast, but at the same time is free to pivot in a vertical plane and adjust itself to the incline of the track cable. The pin connection on which this block pivots is equipped with a lubrication fitting. Details of the mast-top construction are shown in the upper illustration while the installation view shows a 110 ft. mast supporting one end of a 600 ft. span cableway operating a 1 cu.yd. bucket for the Nading Gravel Co., Shelbyville, Indiana.

New Snow Plow

A V-type snow plow has recently been announced by the Acme Road Machinery Co., Frankfort, N. Y., which it is said was designed to meet the need for a light, powerful snow handler more practical and efficient than the truck plow and less cumbersome and expensive than the heavy tractor equipment. The new equipment uses a McCormick-Deering tractor with a rigid frame to which the snow moving parts are attached.

A very important feature is claimed to be the shape and position of the blade which moves the snow by a rolling action rather than a pushing and sliding motion. A patent has been applied for on this arrangement. It is claimed that this feature reduces materially the power required to move the



snow and in addition does a better and cleaner job of snow cleaning.

The side wings are adjustable on either side. All manipulations and adjustments of the snow plow can be made from the operator's driving position. An independent rear axle, mounted in Hyatt roller bearings and geared to the power unit at a ratio of 3 to 1, permits a combination of large diameter wheels, great power and a standard locking device by which both drive wheels may be locked to the rear axle for a combined pull when desired. The main blade can be swung to an angle of 49 deg. with the line of direction. The machine is also equipped with a scarifier.

New Publications

Sanitary Engineering Bulletin—Dorr Co., Inc., 247 Park Ave., New York City, devotes a new 16-page bulletin to the use of its equipment in (1) the treatment of municipal sewerage, (2) the purification and softening of water supplies and (3) the treatment

of industrial waste. Illustrations are given of many present installations at different plants.

Automobile Head Lamps—ELECTRICAL TESTING LABORATORIES, 80th St. and East End Ave., New York, devotes its bulletin 105 to "Testing and Approval of Automobile Head Lamps" in which it describes its methods used in the laboratories. Standard specifications for headlight devices and for tail lights are given as adopted by the Illuminating Engineering Society.

Lighting Data — EDISON LAMP WORKS, Harrison, N. J., a part of the General Electric Co., have available a number of bulletins on lighting. The first known as Index 35 is on "Lighting of Offices and Drafting Rooms"; Index 1 discusses "Theory and Characteristics of Mazda Lamps"; Index 13, "Calculation of the Lighting Installation"; Index 62, "Lighting of the Metal Working Industries"; Index 99, "Motor Car Garage and Display Room Lighting." All the booklets contain valuable information in the form of both text and tables on the various subjects and have been compiled by the company's engineers as practical information. A feature of each booklet is the bibliography giving articles and books that have been published on the specific subjects treated in each of the booklets.

Aluminum Paint—HILL, HUBBELL & CO., San Francisco, has issued a new booklet on aluminum paints and metal primers giving much information on the use and advantages of aluminum paint for many applications. The text of the booklet is arranged in the form of questions and answers, described in the preface as "77 technical questions with 77 non-technical answers."

Portable Pipe Threader — HALL-WILL, INC., Erie, Pa., describes in a new 12-page bulletin its portable pipe threader with a capacity of ¼ in. to 12 in. Features, photographs and details of the machine are described and illustrated.

Concrete Handbook—LEHIGH PORTLAND CEMENT CO., Allentown, Pa., has made available the third edition of its "Contractors Handy Book." It is not arranged as a technical book filled with scientific data, but is devoted exclusively to presenting practical information for every-day reference. It is planned as an aid in solving problems in connection with small jobs in concrete construction. Three separate sections make up the booklet: (1) Plans and materials for about 25 different structures; (2) notes on aggregates, forms, foundations, and reinforcing steel; and (3) tables and data. Many contractors should find this booklet to be a valuable aid.

Centrifugal Pumps—ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., has issued leaflet No. 2064-A, entitled "Type 'S' Centrifugal Pumps," which is a revision of the previous bulletin on the same subject. Illustratons, descriptions and performance curves comprise the contents.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

This Week's Contracts—Week Ago— Same Week Last Year

THE money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings.

Money Value of Contracts Let—Entire U. S.

Week Ending	Public Work	Private Work	Total Contracts
Sept. 16, 1926	$20,307,000	$33,648,000	$53,955,000
Sept. 9, 1926	15,567,000	16,839,000	32,406,000
Sept. 17, 1925	28,860,000	45,006,000	73,866,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
1926	798,447,000	1,259,885,000	2,068,332,000
1925	778,170,000	1,033,608,000	1,811,778,000

Business Briefs

Structural shapes ordered this year total 1,052,042 tons, compared with 1,169,171 in 1925, according to *Iron Trade Review.*

Concrete bars ordered in the first week of September were of far greater tonnage than in the corresponding week of 1925. Total bar awards for 1926 to date are 3 per cent heavier than for that period of 1925.

Electric machinery now under contract with the General Electric Co. include at 208,000-kw. turbo generator for the State Line Generating Co., and two 90,000-kw. electric generators for the Southern California Edison Co. An order has been placed with the Westinghouse Electric & Manufacturing Co. by the Commonwealth Edison Co. for a 104,000-kw. turbo-generator.

Floor and wall tile shipped in the first eight months of 1926 totaled 34,185,993 sq.ft., compared with 28,132,780 in the same period of 1925. This is an increase of 17 per cent in square feet; the increase in value is only 13 per cent. The Department of Commerce reports that prices for selected white ceramic mosaic, ¾ in. square, and for bright glazed standard white wall tile, 6x3 in., are 24 cents and 40 cents per sq.ft., respectively.

Business in the early part of September as measured by the volume of check payments still continues to record increased activity over a year ago according to the weekly statement of the Department of Commerce. Wholesale prices have declined. Loans and discounts of Federal reserve member banks continue to mount, while interest rates on time money are stronger.

See Construction News

Among the announcements in the current Construction News section pp. 59 to 77 are the following exceptionally large projects:

Proposed Work

Institute, Long Beach, Calif., Medical Research Institute having preliminary plans prepared, $25,000,000.

Court House, Milwaukee Co., Wis., making plans, $6,000,000.

Streets, St. Louis, Mo., plans 42 mi. streets, $4,300,000.

Roads, Winnebago Co., Ill., election in November, grading and paving 103 miles, $3,000,000.

Office and store, Chicago, Ill., J. Kulp having preliminary sketches made, $3,000,000.

Roads, Marathon Co., Wis., election Nov. 2, $3,000,000.

Pipeline, Seattle, Wash., making plans, $2,000,000 to $3,000,000.

Cement plant, Houston, Tex., Trinity Portland Cement Co. will build cement plant, $2,000,000.

Office, Seattle, Wash., B. L. Smith, plans office and commercial building, $2,000,000.

Club, Seattle, Wash., Lakeside Club plans club including golf course and swimming pool, $1,500,000.

College, Elmhurst, Ill., Elmhurst College having preliminary plans prepared, $1,500,000.

Theater, Newark, N. J., Fox Film Corp., making plans, $1,500,000.

Terminal, Chelsea, Mass., Eastern Terminal Co., making plans, $1,500,000.

Theater, Brooklyn, N. Y., Fox Film Corp., making plans, $1,500,000.

Apartment, New York, N. Y., B. Gruttman having plans prepared, $1,250,000.

Streets, Montreal, Can., City Council plans election, $1,088,700.

(*Continued on p. 485*)

Sales of Public Bonds Still Falling with August Lowest Since 1923

STATE and municipal bond sales during August were the lowest for any month since September, 1923. According to *The Commercial and Financial Chronicle* the total awards reached $64,224,479 as compared with $89,732,778 in July and $83,727,297 in August, 1925.

The largest two offerings for the month were an issue of $5,000,000 4½'s by the Chicago Sanitary District and two issues of 4's aggregating $4,000,000 by the Chicago South Park District.

The number of separate issues disposed of during August was 522, made by 396 municipalities. The number of issues reached 649 in July, 1926.

The following table compares the totals for August and the eight months for the last ten years:

	August	8 Months
1926	$64,224,479	$867,581,776
1925	83,727,297	980,196,064
1924	108,220,267	1,014,088,919
1923	56,987,954	709,565,710
1922	69,375,996	819,078,237
1921	94,638,755	665,366,366
1920	59,684,048	439,355,455
1919	59,188,857	448,830,120
1918	38,538,221	213,447,413
1917	32,496,308	346,903,907

REPRESENTATIVE PUBLIC BOND SALES, AUGUST, 1926

State	Purpose	Amount	Rate per Cent	Sold For	Basis	Dated	Maturity	Purchased by
Mississippi	.....	$500,000	4½	100.593	4.37	.....	1931-46	Caldwell & Co. and others of Nashville
County								
Allen, Ind.	Road Impvt.	10,000	4½	101.59	4.18	Aug. 1	1927-36	Fletcher Saving & Trust Co. of Indianapolis
	Road Impvt.	267,000	4½	102.91	....	.....	.....	J. F. Wild & Co. of Indianapolis
Benton, Ind.	Road	16,800	4½	101.50	4.19	July 27	1927-36	J. F. Wild & Co. of Indianapolis
	Road	15,600	4½	101.59	4.19	Aug. 15	1927-36	Union Trust Co. of Indianapolis
Buncombe, N. C.	Road and Bridge	1,000,000	4½	102.459	4.53	Aug. 1	1929-35	Guaranty Co. of New York
Clinton and Ionia, Mich.	Road	57,000	4½	100.26	....	.....	.....	Guardian Trust Co. of Detroit
Davies, Ind.	Highway	8,300	4½	101.48	4.20	June 15	1927-36	Fletcher American Co. of Indianapolis
Dubuque, Iowa	Road	300,000	4½	100.706	....	.....	.....	Federal Bank & Trust Co. of Dubuque
Elkhart, Ind.	Road	30,998	4½	102.38	4.21	July 15	1927-46	J. F. Wild & Co. of Indianapolis
Fountain, Ind.	Road	19,000	4½	101.54	4.19	May 15	1927-36	J. F. Wild & Co. of Indianapolis
Genesee, Mich.	Road	45,936	4½	101.01	....	Aug. 1	1928-36	Detroit Trust Co. of Detroit
Gibson, Ind.	Road	19,000	4½	101.59	4.18	Aug. 15	1927-36	Peoples American National Bank of Princeton
Hancock, Ind.	Road	18,000	4½	101.70	4.16	.....	1927-36	Breed, Elliott & Harrison of Indianapolis
Hancock, O.	Road	19,800	5	101.09	4.60	June 1	1927-31	A. T. Bell & Co. of Toledo
Hardin, Ill.	.....	20,000	5	101.87	4.61	.....	1926-35	Bondholders Bond Co. of St. Louis
Henry, Ind.	Road	12,000	4½	101.70	4.16	June 22	1927-36	Breed, Elliott & Harrison of Indianapolis
Holmes, O.	Road	6,900	5½	100	....	July 1	1930-55	Commercial & Savings Bank of Millersburg
Jackson, Miss.	Bridge	275,000	5	100.78	4.57	Sept. 1	1937-36	Union & Planters Bank & Trust Co. of Memphis
Jackson, O.	Road	35,061	5	101.85	4.56	July 19	1927-35	First Citizens Corp. of Columbus
Jackson, Tenn.	Bridge	9,000	5	101.70	....	.....	.....	I. B. Tigrett & Co. of Memphis
Kanabec, Minn.	Drainage	22,000	4½	100.06	4.24	Aug. 1	1932-46	Brewer-Brown & Co. of Minneapolis
Knox, O.	.....	61,530	5	101.72	4.65	Sept. 1	1927-36	Herrick Co. of Cleveland
Lawrence, Ind.	Road	90,000	4½	101.51	4.19	July 15	1927-36	Fletcher American Co. of Indianapolis
Lebanon, Penn.	Highway	100,000	4½	102.12	4.10	July 1	1931-56	First National Bank of Lebanon
Lincoln, Neb.	Bridge	10,000	5½	106.10	....	.....	.....	James T. Wachob & Co. of Omaha
Township								
Reade, Penn.	Road	35,000	5	103.8	4.66	Aug. 2	1931-50	Glover & MacGregor of Pittsburg
Springfield, Penn.	Impvt.	250,000	4½	100.042	4.24	Aug. 1	1931-56	Terminal Title & Trust Co. of Medina
West Lampeter, Penn.	.....	20,000	4½	102.87	....	July 1	.....	R. M. Snyder & Co. of Philadelphia
Municipal								
Aberdeen, Wash.	Bridge	50,000	4½	100.10	4.49	July 1	1928-48	Spokane & Eastern Trust Co. of Spokane
Arkansas City, Kan.	Paving	21,210	4½	101.17	....	.....	1-10 yrs.	Branch-Middlehauff Co. of Wichita
Brocton, N. Y.	Water	20,000	4½	101.15	4.61	Jan. 1	1927-46	Batchelder, Wack & Co. of New York
Chicopee, Mass.	Water	200,000	4	100.78	3.91	Sept. 1	1927-46	Estabrook & Co. and others of Boston
Cottage Grove, Ore.	City Hall	25,000	5	101	4.92	July 1	1946	First National Bank of Cottage Grove
	Water System Impvt.	15,000	5	100	....	June 1	1937-41	First National Bank of Cottage Grove
Cuyahoga Falls, O.	Fire Station	50,000	6	109.23	4.80	April 1	1927-46	Heovick Co. of Cleveland
Dayton, O.	Sewage Disposal	500,000	4½	101.70	4.58	Aug. 1	1927-51	Illinois Merchants Trust Co. and others of Chicago
	Street Impvt.	25,000	5	101.70	4.58	Aug. 1	1927-36	
Dunedin, Fla.	Impvt.	200,000	6	97.50	....	Nov. 1	.....	Dixie M. Hollins of St. Petersburg
Ellisville, Miss.	Sewer and Drainage	40,000	5½	100.45	5.21	June 3	1927-51	Commerce Security Co. of Memphis
Fairfield, Calif.	Water	27,000	4½	102.20	4.62	Aug. 1	1955	Dean Witter & Co. of San Francisco
Glouster City, N. J.	Street Impvt.	381,715	5½	.....	.....	July 1	1932-36	M. M. Freeman & Co. of Philadelphia
Grants Pass, Ore.	Sewer	65,000	4½	102.14	3.82	July 1	1937-46	Ferris & Hardgrove of Portland
Hastings, Neb.	Sewer	150,000	4½	100.14	4.48	Aug. 1	1946	United States Trust Co. of Omaha
Huntington, Penn.	Water Works	200,000	4½	102.39	4.30	July 1	1927-55	Mellon National Bank of Pittsburgh
Johnson City, N. Y.	Sewer	45,000	4½	100.07	4.49	Aug. 1	1927-49	Workers Trust Co. of Johnson
Johnstown, Penn.	Improvement	350,000	4½	100.60	4.17	July 1	1927-46	Mellon National Bank of Pittsburgh
Keytesville, Mo.	Paving	20,000	5	102.28	4.83	Aug. 1	1946	Mercantile Trust Co. of St. Louis
Kingston, N. Y.	Water	150,000	4½	100.49	4.20	Aug. 1	1937-41	Roosevelt & Son and others of New York
Malverne, N. Y.	Paving	100,000	4½	100.029	4.49	Sept. 1	1927-46	R. F. De Voe & Co., Inc. of New York

(*Continued from p. 484*)

Office and store, Chicago, Ill., E. L. Farewell having plans prepared, $1,000,000.

Viaducts, Portland, Ore., City and Multnemah Co. plan system of viaducts, $1,000,000 or more.

Contracts

Sewerage system and disposal plant, North Bergen Twp. Com., N. J. to Clinton Asphalt Co., $1,543,399.

Loft, New York, N. Y., American Bookbinding Co. to White Constr. Co., $1,500,000.

Apartment, Oakland, Calif., Five Hundred Eight Grand Avenue, Inc., to Starr, Thebo & Anderton, $1,500,000.

Hotel, Cedar Rapids, Ia., Krenn & Dato to O. F. Paulon Constr. Co., $1,250,000.

This Week's Special Tabulation of Unit Prices

Steel Sheet Piling

The following unit prices are included in the low bidders' estimates on various contracts awarded, 1923 to 1925, inclusive:

Location	Date	Lbs.	Price per Lb.
Siphon No. 2, Catskill Aqueduct	Mar., 1923	850,000	$0.065
Conduit, Brooklyn, N. Y.	Feb., 1925	500,000	.06

		(Sq.ft.)	(Price per sq.ft.)
N. Y.-N. J. Hudson River Tunnel	June, 1923	137,000	1.50
Coagulation Basins, Kent, O.	June, 1924	1,500	1.58

INTERLOCKING

		(Net tons)	(Price per net ton)
Subway, Philadelphia, Pa.	Sept., 1923	50	$98.00
Intake, Denver, Colo.	May, 1924	5	50.32
Subway, Philadelphia, Pa.	Aug., 1924	50	100.00
Subway, Philadelphia, Pa.	Oct., 1924	100	110.00
Subway, Philadelphia, Pa.	Mar., 1925	100	150.00
Subway, Philadelphia, Pa.	Aug., 1925	100	125.00
Subway, Philadelphia, Pa.	Nov., 1925	100	110.00

Contractors' Information Bureau
See p. 77 Construction News Section

Weekly Construction Market

SUCH changes as have occurred in business during the week have been mainly in the right direction. It is the season now, with the summer and the vacation period practically ended, when operations should normally broaden, and there are comparatively few discordant notes in current dispatches from the principal commercial centers. There are, moreover, a number of evidences of an unprecedented volume of trade in the aggregate. Foremost among these is the latest report on railroad freight traffic, which surpasses the remarkable exhibits of previous weeks this year and even exceeds the record that had been unmatched since the closing week of August, last year. This striking proof of a notably heavy distribution of general merchandise, which of itself testifies to a sustained public buying power, is supplemented by other favorable statistical comparisons. Despite lower commodity prices, on the whole, bank clearings at several of the leading cities still show gains over those of a year ago, when the totals were unparalleled up to that time; building permits, although not equaling some former high marks, indicate much activity in new construction in various sections; output of steel is rising; and the trend of production of textiles and of footwear is upward. The expansion that appears in different channels of trade is the more gratifying because it is unaccompanied by speculative excesses, the policy of limiting commitments to actual needs being rigidly adhered to in nearly all instances. The facility with which supplies can be obtained in most cases obviously tends to prevent competitive bidding for goods, and price fluctuations, for the most part, are kept within a narrow range. Such a condition naturally adds to the stability of business, and the outlook for autumn is distinctly promising.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb	$3.34	$3.80	$4.15	$3.10	$3.35	$3.07½	$3.30	3.35	$3.75
Structural rivets, 100 lb	4.20	3.80	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb	3.24	2.80	3.38	2.60	2.87½	3.77½	2.95	3.25	2.50
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	53.6%	51%	54.25%	36%	35.6@49.2%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	52.60@53.60	45.25	54.00	49.20@50.20	53.00	64.00	50.00	55.00	55.00
Concreting Material									
Cement without bags, bbl	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	1.60	1.65	1.90	1.80	1.50	1.50
Sand, cu.yd	1.00	1.60	2.00	1.40	1.25	1.00	1.40	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.90	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	62.00	34.00	56.00	40.50	38.25	34.75	27.00	23.00	50.00
Lime, finishing, hydrated, ton	18.20	23.50	19.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl	2.10@3.00	1.50	1.82	2.25	1.60@1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	10.50	14.10	12.00	13.75	9@10	15.00	15.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	.075	.076	.075	.....	.09	.10
Hollow partition tile 4x12x12, per block	.1112	.0895	.112	.075	.076	.075	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, gal	—.93	.99¾	1.10	.92	—1.00	1.14	1.04	1.12	1.03
Common Labor									
Common labor, union, hour	.90⅝	.30	.....	87½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	82½	.45@.60	40@.45	.50	.50	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06¼; building laborers, 90⅝c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Sept. 2 the next on Oct. 7.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) and shapes, l.c.l.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.156). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) and shapes, less-than-carload lots.

Business Briefs

Call money quoted at 5 per cent, Sept. 14; year ago 4½ per cent.

Time loans: Sixty-ninety days, 4¾; four-six months, 5 per cent.

Commercial paper: Best names 4½ per cent; other names, 4¾ per cent.

On Sept. 1, 1926

E. N.-R. Construction Cost Index Number 208.30

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For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month